TECHNOLOGY DEPT.
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# POWER

JANUARY, 1944

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY

*Metalclad cubicles with air circuit breakers control auxiliary power distribution*

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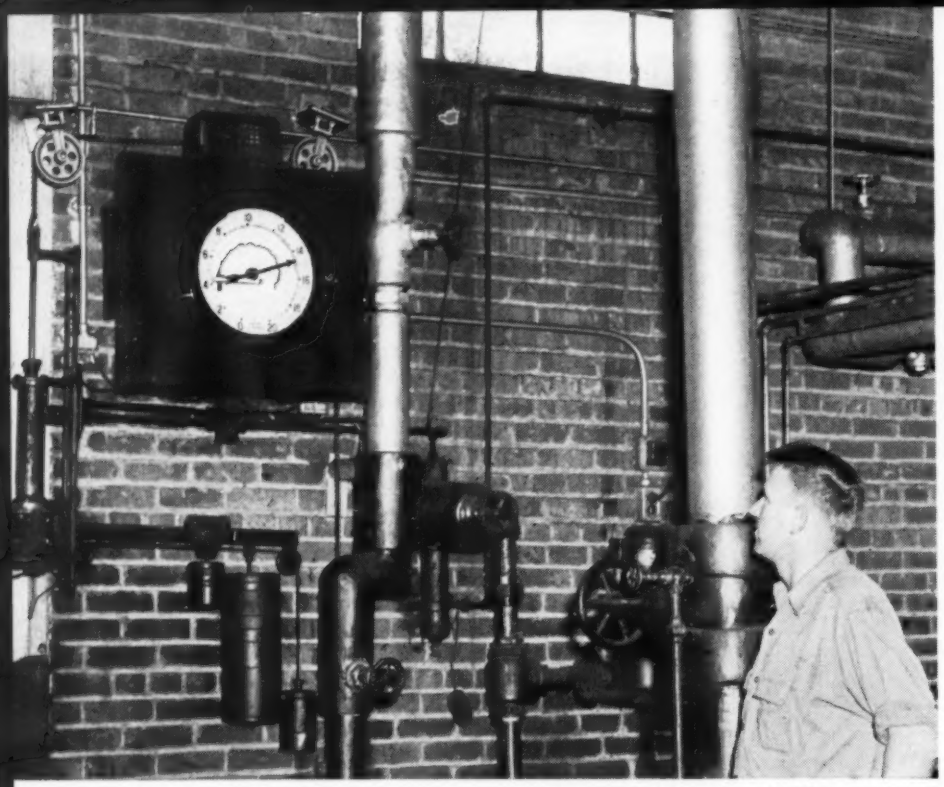
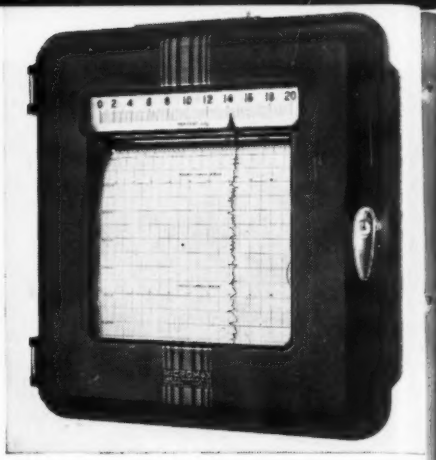
**New kilowatts** mill Utah copper — single 50,000-kw 850-psi condensing turbine serves high load-factor requirements; giant 48-cell cooling tower pinch hits for non-existent river; adequate treatment licks tough makeup problem. Story starts pg 64

**Gas turbines** progress toward their future place in the stationary, locomotive and marine fields. Temperatures of 1200 F. now practical, yield thermal efficiencies of 30 . Experiments with pulverized coal appear promising. See article beginning on page 92



Located high above the floor so that it can be read far down the firing aisle, this Micromax Round Chart $CO_2$ Recorder helps a New York State plant to save coal by improving combustion beneath its stoker-fired boilers.



The Strip-Chart form of Micromax $CO_2$ Recorder is preferred by some users.

But the comment came quickly enough after a few installations had been made, because the new device overcame the standard objections to automatic $CO_2$ meters—it was sensitive, it was not easily damaged in use, and it required practically no servicing. Users checked it; found it accurate; could see for themselves its other qualities; came to depend on it.

Today, wherever any thermal-conductivity-method recorder can be used, these advantages of sensitivity, sturdiness and low maintenance can be enjoyed. If you have a $CO_2$-analysis problem, one of our engineers will gladly tell you more about Micromax. If you prefer a quick, clear, printed description, ask for Catalog N-91-163.

# TRYING TO SAVE FUEL?

## Maybe a Micromax $CO_2$ Recorder Can Help

Freed by the Micromax $CO_2$ Recorder from the job of analyzing flue-gas, at frequent intervals, many a plant engineer is saving fuel simply because he knows more about $CO_2$—and knows it more quickly—than ever before. For when the Micromax shows the need of a change in air supply to the boiler, the engineer makes the correction with speed; and quickly sees the result on the Recorder's chart. He can tell, from minute to minute if he wishes, just how combustion stands in relation to optimum efficiency. And he has the $CO_2$ records to help plan future operating savings.

One of the outstanding successes of modern instrumentation has been scored by this Recorder. Coming into the power field when $CO_2$ recorders were widely regarded as not practical, this instrument was on a "make good if you can" basis in every early installation. Two or three types of $CO_2$ meters were already available; the arrival of still another didn't rouse much comment—at first.

Micromax Recorders for Flow, Temperature and $CO_2$, being mounted, together with Metermax Combustion Control, on a boiler-control board before shipment from our plant. These panels arrive ready for connection to boiler, etc.; greatly simplify the installation.

*depends on me!*

**A Slogan For Every American**

Jrl Ad N-91-163(12)

**LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.**

**LEEDS & NORTHRUP**

**MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES**

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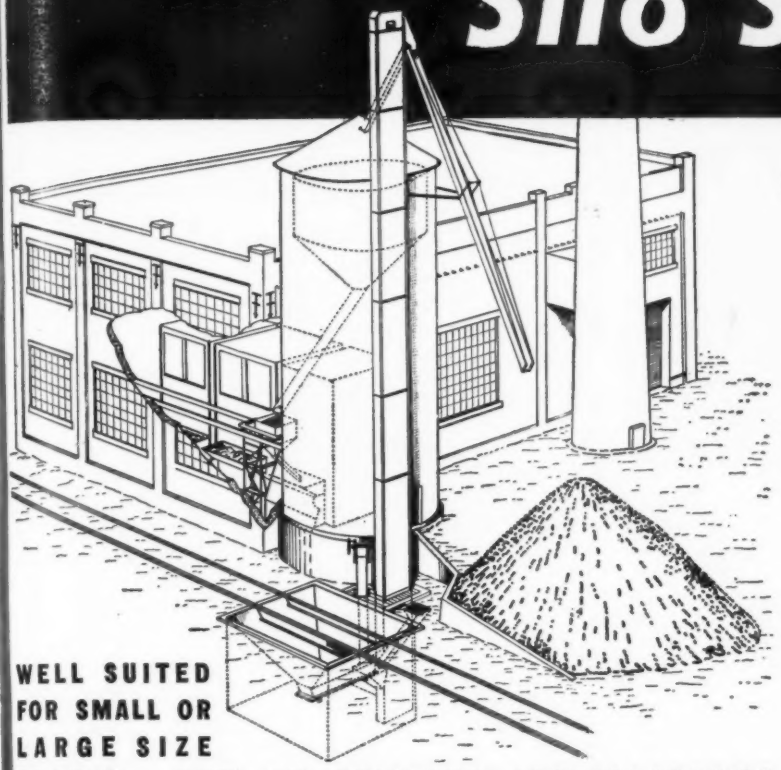
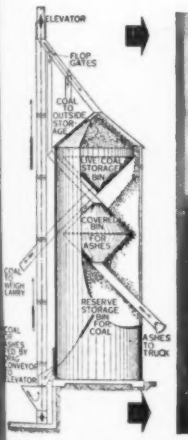
# COAL AND ASHES HANDLING SIMPLIFIED WITH THE Silo System



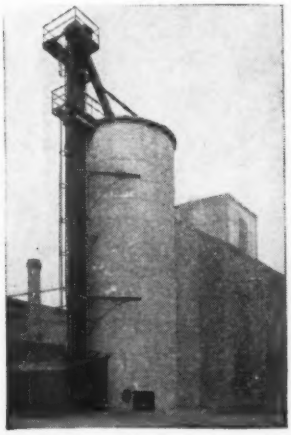
WELL SUITED FOR SMALL OR LARGE SIZE PLANTS — NEW OR EXISTING INSTALLATIONS

## Combines Supply and Handling Functions in One Compact Economical Unit

Usually silos are located adjacent to the boiler house but constructed independently, and equipment within the boiler house consists entirely of means for distributing the coal. Frequently a single spout from the silo is all that is needed. Silos may be designed for normal storage requirements or equipped with an auxiliary spout to provide additional outside reserve storage when desired. This system may be arranged to store both coal and ashes. The installation shown above handles coal only, supplying the boiler house from active and reserve storage within the silo and storing out additional reserve ground storage. A traveling weigh larry receives coal from the live storage hopper of the silo and distributes it to the stokers. Talk over your problems with our experienced engineers.



Both coal and ashes are handled here. Coal may be diverted to ground storage through an auxiliary spout. Ashes are discharged to the ashes section of the silo by means of a control gate and independent spout.



Another typical silo installation handling coal only, but without auxiliary ground storage. Coal from the live storage hopper in the silo is spouted directly to pulverizers located inside the building.

**LINK-BELT COMPANY**

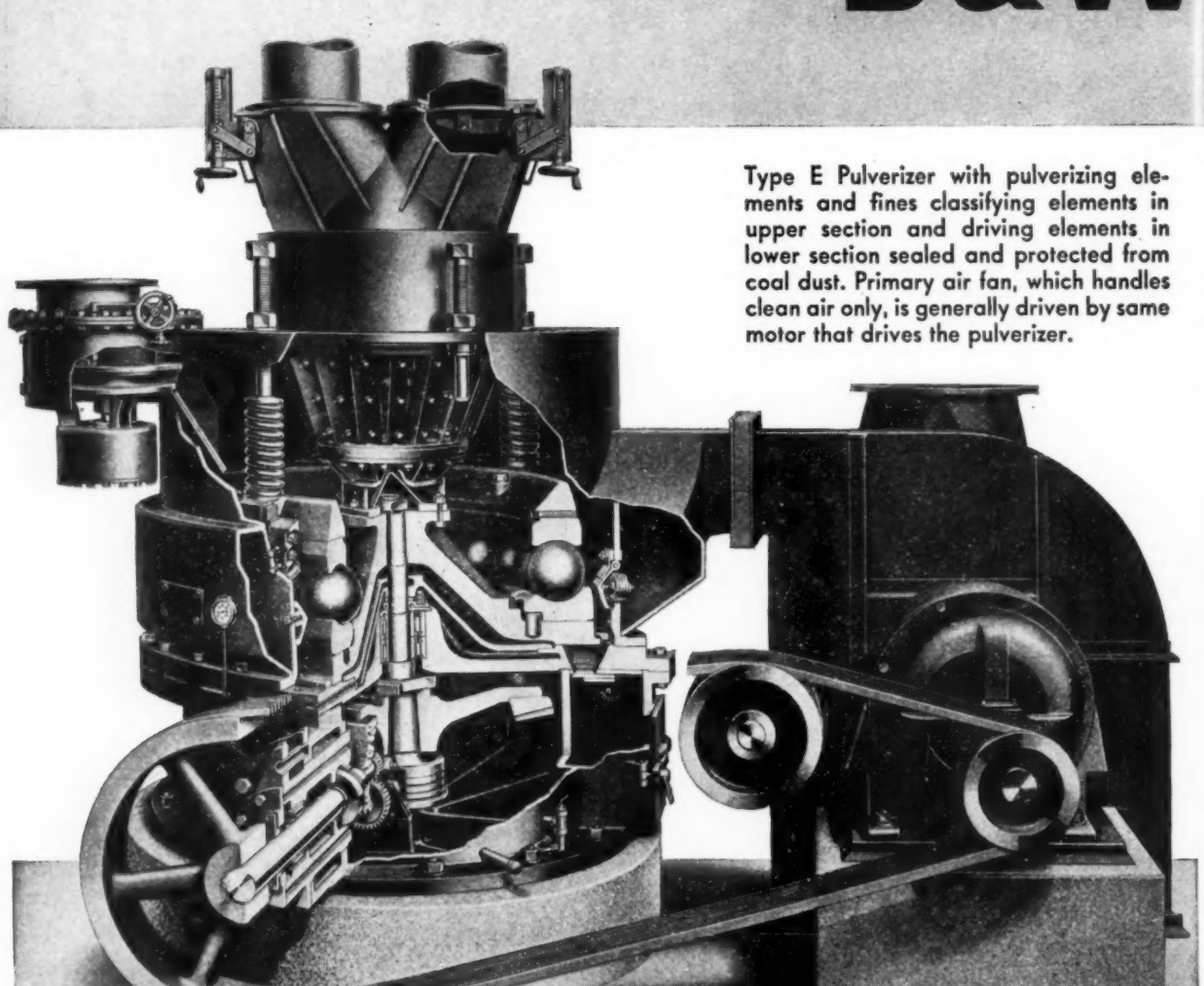
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8. Offices, warehouses and distributors in principal cities.
9190-A

# LINK-BELT

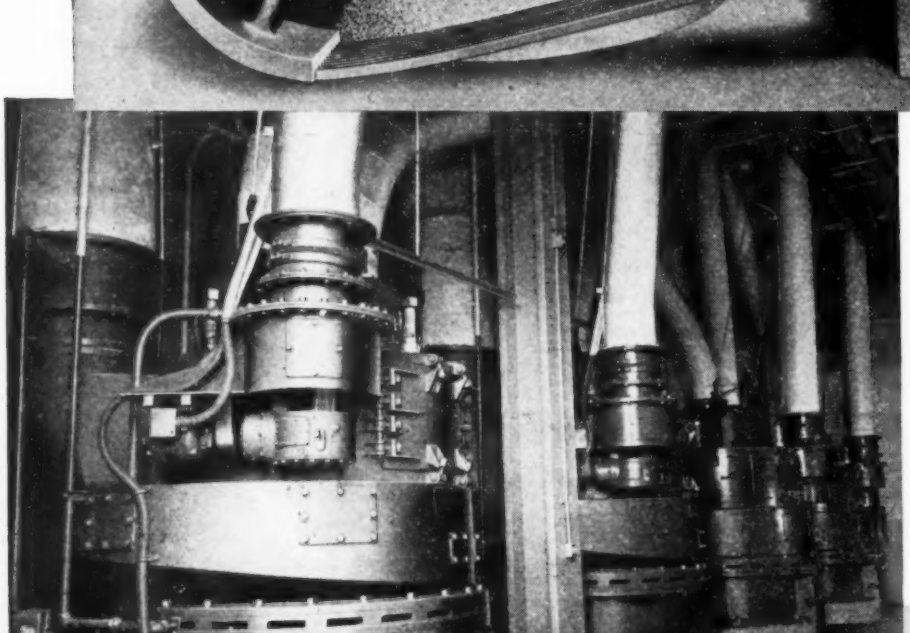
## . . . Coal And Ashes Handling Equipment

CONVEYORS • ELEVATORS • SKIP HOISTS • CRUSHERS • LARRIES • SCREENS

# The B&W



Type E Pulverizer with pulverizing elements and fines classifying elements in upper section and driving elements in lower section sealed and protected from coal dust. Primary air fan, which handles clean air only, is generally driven by same motor that drives the pulverizer.



Over 400 Type E Pulverizers are i service or on order for direct firin boilers. Individual installations hav as many as 16 units.

# Type E Pulverizer

## Fits into Any Day's Fuel Picture

### *Operates reliably and effectively in direct-firing pulverized-coal systems*

By every standard of direct-firing pulverizer performance, the Type E Pulverizer fits into the fuel economy picture any day, and especially so during the present emergency requirements.

**Type E Pulverizers—**

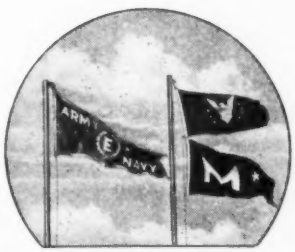
Are reliable in service and low in maintenance, as measured in service hours before replacement of parts becomes necessary.

Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

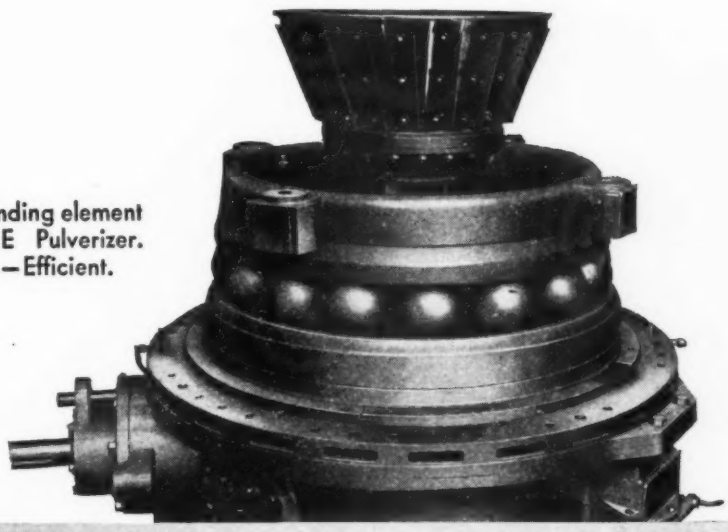
Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.



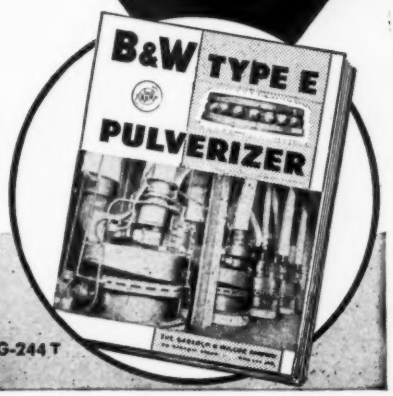

The Army-Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.

**THE BABCOCK & WILCOX COMPANY**
**85 LIBERTY STREET, NEW YORK, N. Y.**



Ball-bearing grinding element of the Type E Pulverizer. Simple—Sturdy—Efficient.

For a copy of this bulletin return this pasted on a penny post card with your name and address.




# BABCOCK & WILCOX

G-244 T

Controlled
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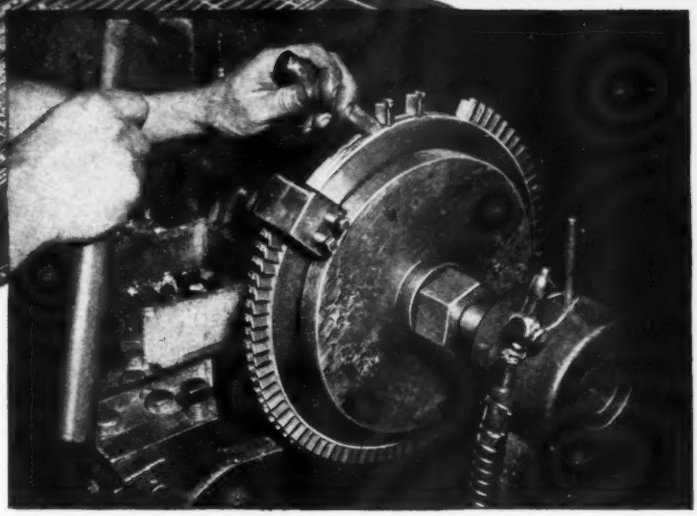
Engineering
insures fine
ELLIOTT



*Driving turbine buckets into place on the wheel. Very close fit of buckets in their formed slot insures permanent tightness.*

# drive fit needed here – *make that tolerance .00025!*"

The fitting of turbine buckets is an exacting operation. Anything other than a permanent tight fit in the disc slot would result in vibration and eventual bucket failure. So Elliott engineers dictate a very close tolerance and special gauges for this detail. Pretty close work, and naturally real skill is required, but it is essential to the kind of performance expected of an Elliott turbine. This is the opinion of Elliott engineers — an opinion based not only on established standards but also on their many years of turbine-building experience.

The entire Elliott turbine is built with the same seasoned engineering judgment applied to dimensions, tolerances, materials, production methods, and other engineering features which affect ultimate performance. Certain design features are perhaps better than they need to be for small turbines, but many users want a turbine that needs no pampering, that will give uninterrupted service under any reasonable conditions (and some pretty unreasonable). They get such service from Elliott turbines.

**The booklet about these turbines will give you very interesting factual evidence and data. It is valuable to have on file, even though you may not immediately need turbines. Write for a copy.**

## ELLIOTT COMPANY

STEAM TURBINE DEPARTMENT, JEANNETTE, PA.

*DISTRICT OFFICES IN PRINCIPAL CITIES*

A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

H-876

# TURBINES for MECHANICAL DRIVE

# How to Straighten a Warped Soot Blower Element

Soot Blower Elements—the pipe sections with nozzles within the boiler—meet such severe service conditions that they sometimes become badly distorted. Wartime difficulty in obtaining replacements quickly makes it important to know how to straighten distorted elements with minimum risk of breakage.

Diamond elements are made in three types for various temperatures:

**Plain Elements**—made from extra heavy seamless steel tubing with the distal ends closed by spinning. Venturi type nozzles are electrically welded into the tubing. They can be readily recognized as steel tubes.

**Calorized Elements**—made from extra heavy or double extra heavy seamless steel tubing with the distal end closed by spinning, and Venturi type nozzles electrically welded into the tube walls are then impregnated with aluminum both inside and outside. They can be recognized by their bright appearance.

**Dialoy Elements**—made from seamless chrome iron tubing having a very high percentage of chromium. The distal ends are spun closed and Venturi nozzles are formed by building up a pad of alloy on the outside of the tube and drilling the nozzle through the pad and tube wall. Dialoy elements may be recognized by these welded pad nozzles and their yellow painted distal end.

**Straightening Elements**—If an element is not too badly distorted and the bearings are in proper alignment, it is frequently possible to straighten the element without removing it from the boiler. This is done by turning it to the point where it binds hard in the bearings and then leaving it in this position for a few hours.

If the element is so badly distorted that this method does not straighten it, remove it from the boiler.

Heat Calorized and plain steel elements to a cherry red (about 1500° F.) and then lay on a level floor or other surface. A wooden block should then be used to tap out the bent sections. The entire element should be heated at one time if at all possible; if not, the bent sections may be heated separately.

Dialoy elements should be heated to about 1650° F. (between a bright red and orange) and the same straightening process used as for Calorized and steel elements. After straightening, Dialoy elements should be quenched in water. If they cool considerably while being straightened, they should be reheated to 1650° F. and then quenched. Quenching of high chromium alloys softens or anneals the metal.


**DIAMOND POWER SPECIALTY CORP., Detroit, Michigan**

**DIAMOND SPECIALTY LIMITED · Windsor, Ontario**

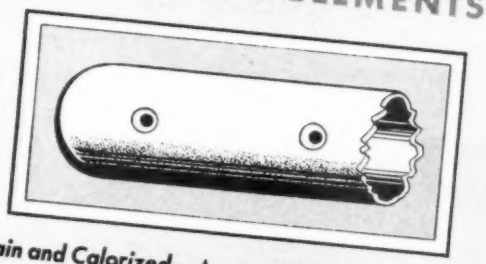
**Diamond Soot Blowers Have Been "Drafted"**

***Careful Treatment Will Prolong the Life of Those You Have***

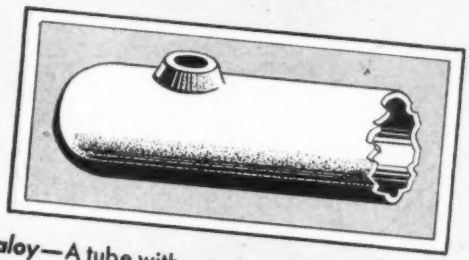
**Almost the entire production of the Diamond plant is "drafted"—earmarked for war production. Hence, it is to your interest to make the soot blowers you have last as long as possible.**

**This is the second of a series of advertisements telling you how to do it. Send for a copy of the booklet on the care and maintenance of Diamond Soot Blowers.**

## THREE KINDS OF BLOWER ELEMENTS



***Plain and Calorized***—A smooth tube with a row of welded holes (nozzles) is either a plain or calorized element.



***Dialoy***—A tube with a row of pads through which nozzles are drilled is a Dialoy element.

## HEAT FOR STRAIGHTENING

Heat plain and Calorized elements to 1500° F.—cherry red.

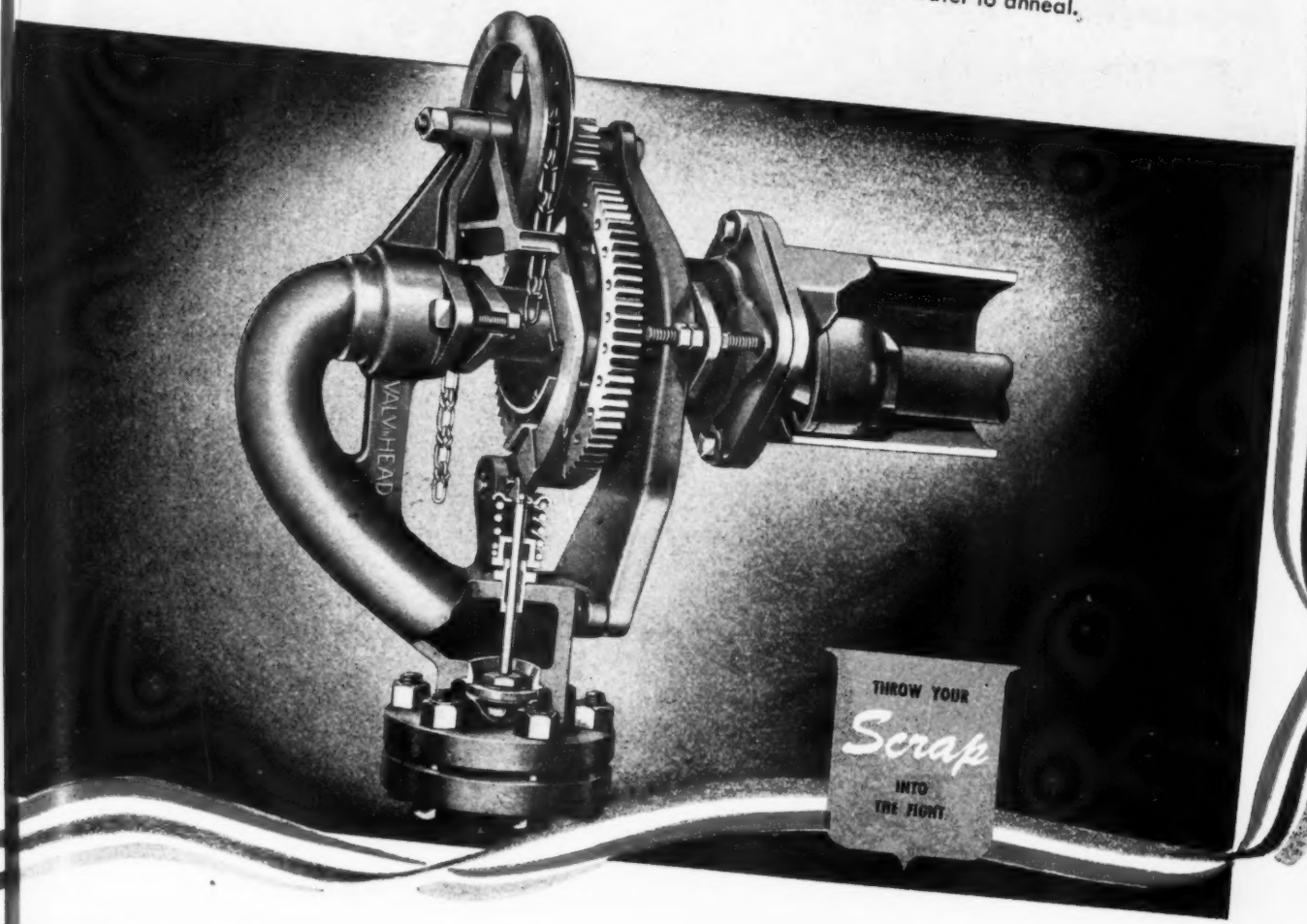
Heat Dialoy elements to 1650° F.—between bright red and orange.

## ROLL ON FLAT SURFACE TO STRAIGHTEN

Tap at warped places with a wooden block. If the element cools considerably before straightening is complete, it should be reheated.

## DIALOY ELEMENTS ONLY

Should be quenched in water to anneal.



# "FUEL CONSERVATION

"Th

**BAILEY METER CONTROL**

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

# THAT'S EASY!"

## Engineered Instrumentation Helps Me to Maintain Production Schedules On Less Fuel."

★ "Fuel conservation through efficient combustion has always been one of my objectives, but now it is my patriotic duty as well.

"Every ton of coal, every barrel of oil, and every cubic foot of gas not burned in our boiler plants means that we have freed transportation facilities and manpower for other war activities.

"Engineered instrumentation makes it possible for us to conform with wartime conservation measures through increased efficiency rather than at the sacrifice of product output. There is more to engineered instrumentation than the purchase and installation of meters and controllers. It includes qualified, on-the-spot engineering advice regarding selection, application, installation, and adjustment of equipment to the particular requirements of your plant.

"To serve power engineers in this all-important phase of instrumentation, Bailey Meter Company maintains a staff of over 100 engineers who have been thoroughly trained in combustion and automatic control practice. They are located in over 30 industrial areas throughout the United States and Canada and are readily available to help you with problems of fuel conservation, power plant safety, continuity of operation, and boiler capacity. The Bailey Engineer not only helps to select and install suitable equipment, but he considers that his duty is not discharged until the equipment is in satisfactory operation and you are securing the desired results in the form of economies and improved performance.

"The Bailey Engineer in your community has a wide background of combustion engineering know-how at his command. It covers combustion tests on thousands of boiler installations including a wide range of fuels, furnaces, and fuel burning equipment. If you do not already know him, get acquainted at your next opportunity since he is a man who can help you with seasoned engineering service."

★

**BAILEY METER COMPANY**
**1036 IVANHOE ROAD, CLEVELAND 10, OHIO**
**Bailey Meter Company Ltd., Montreal Canada**

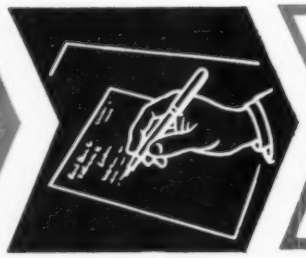
G-18

*The Complete Combustion Control System*

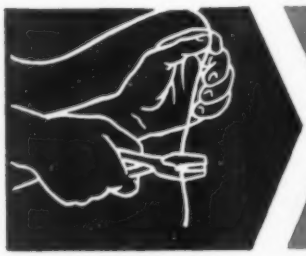
SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

# You Save[1] and Save[2] and Save[3]

**1 SAVE ORDERING TIME**



Instead of buying two separately mounted devices—a motor-circuit switch and a magnetic starter—you buy one factory-co-ordinated unit that controls and protects your motor. Simply specify the motor rating and indicate the type of motor-circuit switch you want—and we'll send you the control you need.

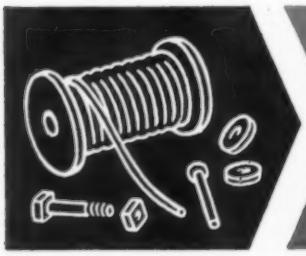


**2 SAVE INSTALLATION TIME**

Users report a 50 per-cent reduction in mounting time, 40 per-cent reduction in wiring time, as compared with the installation of two separate devices. You mount one device—not two. You connect only nine terminals—not fifteen. You get your motors into operation quicker.

**3 SAVE MAN POWER**

By eliminating one complete mounting job on every installation, you save valuable man power. And because the cover cannot be opened while there is power on the starter, your men have more protection against accidental injury.

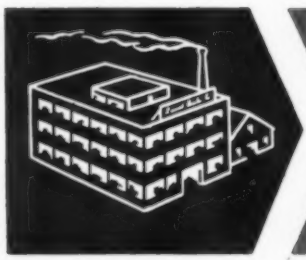


**4 SAVE CRITICAL MATERIALS**

By buying both the motor-circuit switch and the magnetic starter as one compact unit, you save copper wire, steel conduit, and fittings that are necessary for installing two separately mounted devices—plus the saving gained by using only one steel enclosure instead of two.

**5 SAVE MONEY**

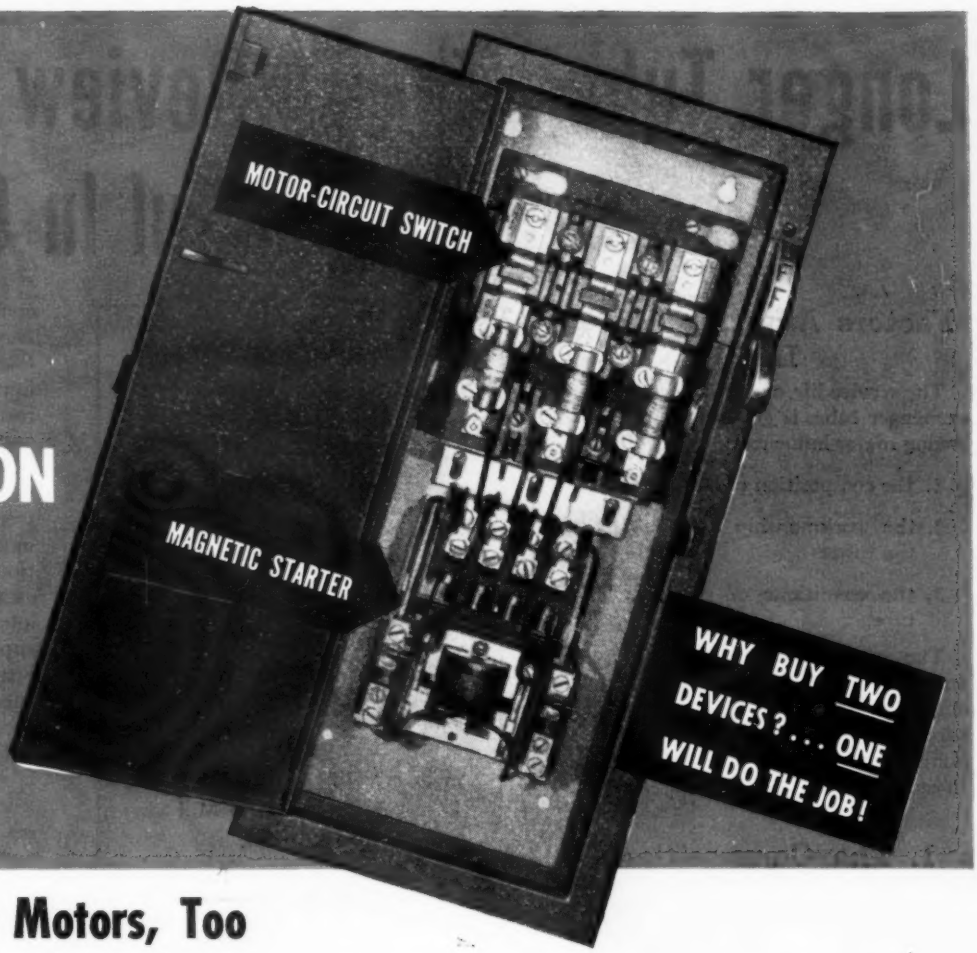
Combination starters cost slightly more than two separately mounted devices, but this difference is more than made up by the savings in wire, conduit, fittings, and installation-labor costs. This statement is based on the actual experience of users.



**6 SAVE PLANT SPACE**

Combination starters take up less mounting space than separately mounted safety switches and starters. Because of this you can mount them in small, unused places near the operators.

# and Save[4] and Save[5] and Save[6]---




## COMBINATION STARTERS

## ---and Save Your Motors, Too

With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating and interrupting capacity for the magnetic starter with which it is used. The fuses or breaker are coordinated with the thermal overload relays to give complete motor protection under short-circuit or overload conditions.

It's the simple, logical way to get control and protection for your motors—in one compact, easy-to-install unit. Why buy two devices, when this one will do the job?

**NAME YOUR HAZARD**

G-E combinations come in enclosures to meet any operating condition: dust-tight, watertight, oil-immersed, general-purpose, or for hazardous locations. Available for motors from 1 to 1000 horsepower.

**GENERAL ELECTRIC**

Next time you order motor control, save seven ways by specifying General Electric combination starters.
*General Electric Company, Schenectady, N. Y.*

***Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.***

General Electric Company, Section B676-129
Schenectady, N. Y.

Please send me the bulletins checked below:

- GEA-3715—Combination starters: general-purpose, watertight, and dust-tight
- GEA-3660-2300-volt combination starters
- GEA-3804—Combination starters for hazardous locations
- GEA-3541—Oil-immersed starters

Name.....

Company.....

Address.....

City.....State.....

8920

# Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 1

# Longer Tube Life . . A Review Of Information Helpful In Obtaining It

## Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors. Some discussion is therefore devoted to each of them.

## 1. The Composition of the Alloy

The nonferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Most of the tube alloys carry trade names which usually identify them, as for example, muntz metal, naval brass, admiralty metal, red brass, aluminum brass, etc. The choice of any particular alloy for a particular service is based on the known behavior of such alloys under any definite set of conditions, on previous service experience of tubes in the unit in question or similarly operated units, and on the type or form of corrosion which predominates. It may be pointed out, by way of illustration, that copper and alloys of high copper content (85% or over) are not generally recommended for service where corrosion by hydrogen sulphide or similar sulphur compounds is known to be severe; likewise, muntz metal and other alloys of brass high in zinc content (which contain no inhibitive agent) are not serviceable under conditions where serious dezincification may be experienced. On the other hand, tubes of aluminum brass or copper-nickel withstand mechanical abrasion or erosion-corrosion better than other alloys.

Article No. 6 discusses how the right alloy can be selected for the actual operating conditions.

### Scovill War-Information Service to Save Scarce Tube Metals

During 1943, *Scovill Tube News* has presented a series of articles on condenser and heat exchanger tubes . . . with the objective of pointing out to engineers certain steps which will be helpful in obtaining longer tube life. This issue reviews the previous articles. Copies of any or all of the articles are available upon writing to Scovill Manufacturing Company, 13 Mill St., Waterbury 91, Conn.

## 2. Workmanship and Quality of Tubes

The physical or mechanical condition of condenser and heat exchanger tubes is relatively less important as a contributing factor of corrosion than the service conditions to which they are exposed. Nevertheless, deep scratches, seams, folds, unsoundness or other serious metal imperfections in tubes may initiate corrosion of a severe electro chemical type and should be avoided. A high standard of quality in the manufacture of tubes, therefore, is required to insure freedom from this source of trouble. Each step in the production of tubes from the selection of the raw material, through the casting, to the extrusion, drawing and annealing operations requires careful supervision. Mechanical and chemical tests are necessary both on the finished tubes and on material in process. Close cooperation is maintained between Scovill manufacturing departments and the laboratory not only for necessary control work but also for developing new processes, new corrosion-resistant alloys or for any other work leading to technical advancement in the manufacture and use of condenser and heat exchanger tubing.

## 3. Conditions of Service

Heat exchanger tubes may be required to withstand or resist corrosion by various media under widely varying service conditions. The rate, form and intensity of corrosion of tube materials, and hence their period of service, depends upon the predominating or controlling factor or a certain combination of factors which may be found active for each individual installation. A study and appreciation of these factors as they apply to any particular corrosion problem is necessary not only in the selection of the most satisfactory and economical tube material, but in the proper control of such factors as may be required to extend tube life. The following list covers the most important of the factors which influence corrosion:

a. Temperature (tube-wall)

b. Velocity of media in contact with tubes

c. Hydrogen ion concentration

d. Oxygen concentration

e. Composition of corroding media

f. Stresses acting upon tubes

g. Contact with dissimilar metals

The influence of each of the above factors is considered in Articles No. 2 and 3.

Better understanding of the common causes of corrosion can be obtained from Articles No. 4 and 5, which discuss:

Film formation

Accelerated uniform corrosion

Impingement attack, end corrosion, etc.

Concentration cell action

Deposit attack

Plug- and Layer-Type Dezincification

Galvanic action

## One of 3 Scovill Services

This series of advertisements in the form of articles is an adjunct to a complete plan of "Service in Manuals" provided by Scovill engineers — one of the three "Scovill Services". Further information will be found in Scovill's "Condenser Tube" booklet, containing diagrams, formulae, descriptions of alloys.

The second of Scovill's services is "Service in Men", which places at your disposal the knowledge of men with years of specialized experience. The third is "Service in Metals", which offers you complete laboratory and production facilities, available as national needs permit.

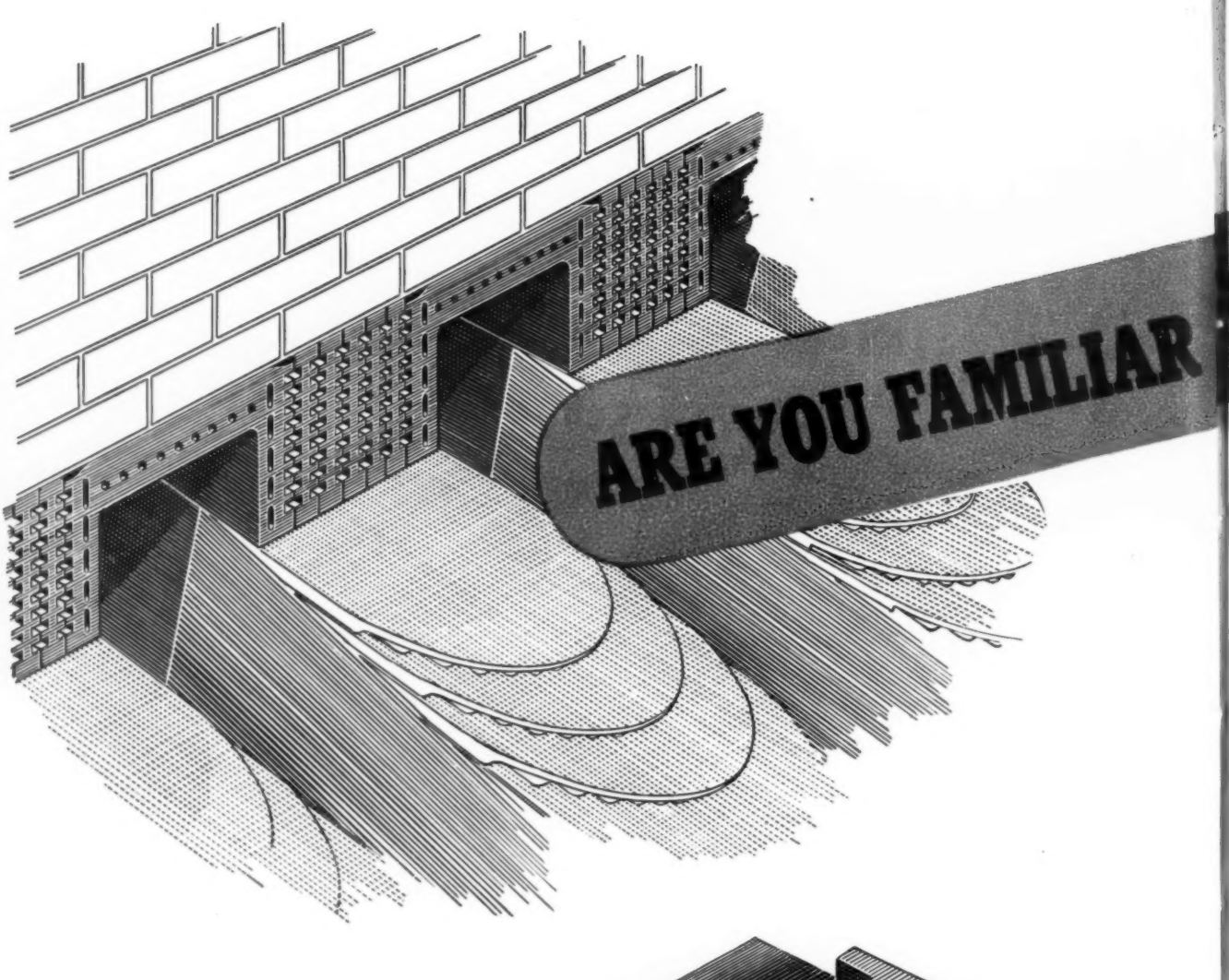
**Limitation order L-154 issued by the OPM, limits the use of nonferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No nonferrous metals containing more copper and more tin than these two are permitted by the order.**

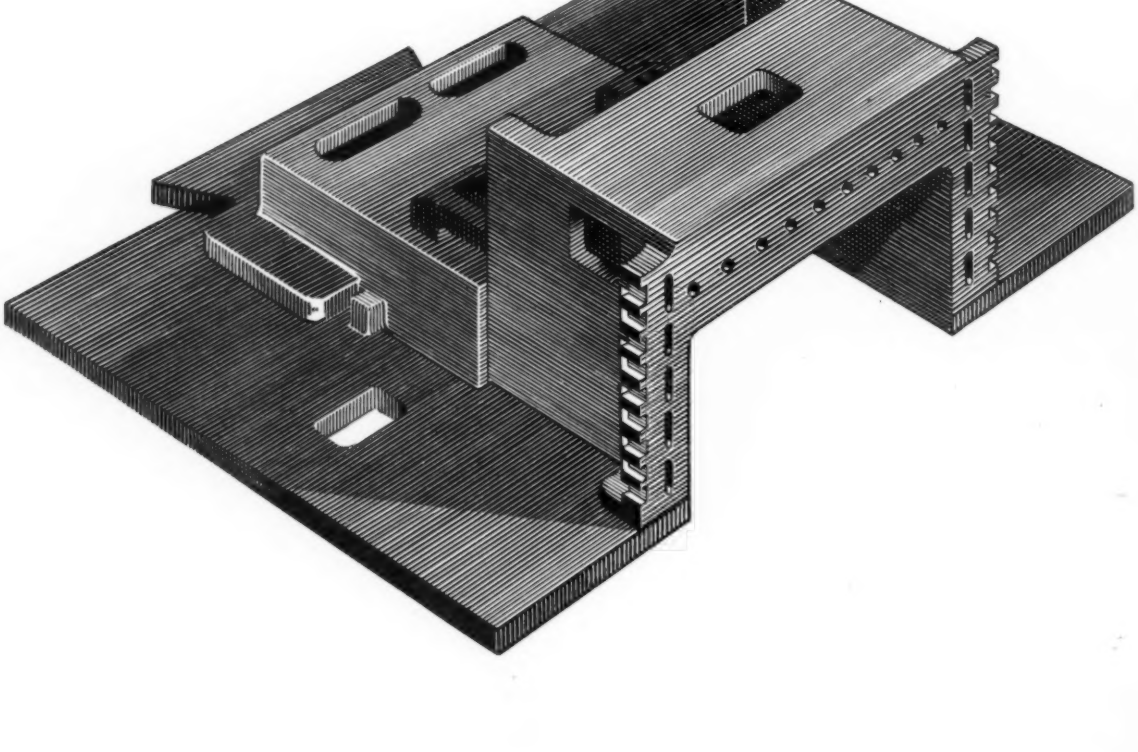
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

# SCOVILL CONDENSER TUBES

*ONE PRODUCT . . . THREE SERVICES*

**Service in Manuals . . . Service in Metals . . . Service in Men**


ARE YOU FAMILIAR



# WITH ALL THESE FEATURES of the

# FRONT WALL AIR BOX?

TAYLOR Front Wall Air Boxes and air cooled ram box caps work together to spread a screen of air across the stoker front wall. This action reduces clinker and slag formations, cuts labor and material costs of front wall maintenance, adds to operational freedom and efficiency.

The Front Wall Air Boxes and Air Cooled Ram Box Caps, like other features, add to the efficient, reliable, low cost operation of Taylor Stokers in generating steam.

Taylor air boxes and caps provide for lower costs in five other ways:

1. Replacements, easily made, are confined to short narrow vertical bars.
2. The Hi-Angle ram box cap provides for better packing of fuel at the mouth of the retort.
3. The cap improves the contour of the upper section of the fuel bed.
4. An air box bar is an integral part, on each side, of the ram box cap extension. This adds strength and permits the sides to be air cooled.
5. Two hooks which form a part of the ram box cap extension not only make it secure, but reduce the labor required for replacement.

## JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

**1. RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.

**2. CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

**3. MAINTENANCE**—the ability to operate continuously with minimum repair costs.

**4. FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

**5. EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

**6. OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

**7. ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

**8. FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

**9. REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

**10. STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.

**11. SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

**12. OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

**A-E-CO TAYLOR STOKER**

AE CO 75

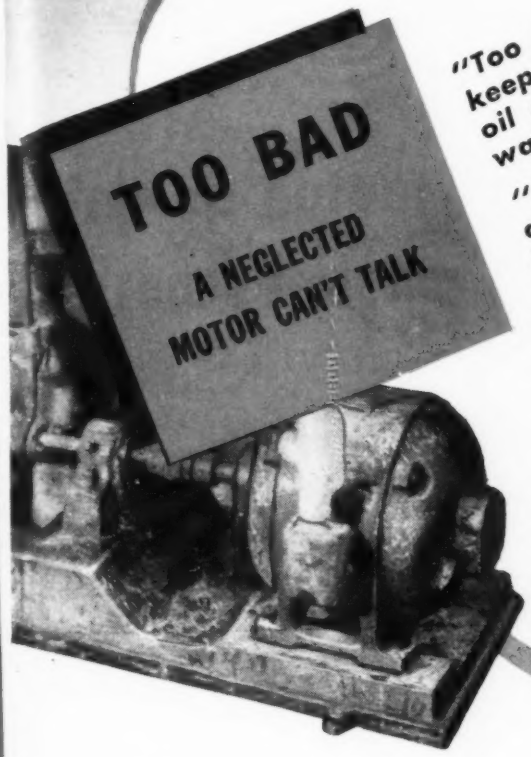
# AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA


DETROIT PUBLIC LIBRARY

One million Goodyear Steel Cable V-Belts — now smashing all performance records on the toughest drives in industry and on military equipment — prove this Goodyear development to be the most efficient, longest-lived, most perfectly matched, Heavy-Duty Belt that ever turned a Multi-V drive. It handles drives no other type V-Belt will pull! Ask the G.T.M. — Goodyear Technical Man.
GOODYEAR INDUSTRIAL RUBBER PRODUCTS
GTM - Specified STEEL CABLE V-BELT for Multi-V drives
1. Heavy, super-tough black cover with uniform friction, longer life
2. Load-carrying, endless, steel cables in neutral plane
3. Tension and compression sections of high-quality rubber
GOODYEAR
THE GREATEST NAME IN RUBBER

★ *LET'S ALL BACK THE ATTACK—WITH WAR BONDS* ★




"Too bad for me all right, if they keep giving me the go-by with the oil can. Another day or two and—war or no war—I'm going to quit!"

"Can't really blame Joe for it either. With all the extra work he's been doing over in the annex, he had to cut down somewhere, I suppose."

"Brrrr—here come the 'shakes' again, all on account of that loose bolt in the base plate. If only I could holler 'Uncle,' instead of just sitting here battering my bearings out."

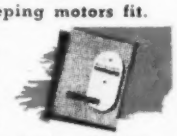
"Funny how people are. After I pass out tomorrow there'll be a regular clinic around here. Once I'm a 'has-been,' I'll be the most important motor in the shop."

# Preventive Care of Motors

## . . . IS A MANAGEMENT PROBLEM

## HERE'S HOW G.E. CAN HELP YOU SOLVE IT

**A regular schedule for oiling, cleaning, and inspection of every motor is half the battle in keeping motors fit.**



The G-E booklet "How to Care for Motors" tells what to do and when to do it. You can use it as a basis for issuing definite instructions, and for analyzing the hours of work involved so that your maintenance crews can be adequately staffed. Ask for GEA-2856A.

To save time in ordering renewal parts and to make it easier for you to get genuine G-E parts, consult the G-E Renewal Parts Catalog. This 96-page publication will help you keep your old electric apparatus operating in wartime. It contains a condensed listing of the renewal parts which you are likely to require most frequently for standard G-E apparatus. Ask for GEA-638.

Free G-E Motor Record Cards (GES-1526A) make it easy to keep a convenient record of the specifications and service history of every motor in your plant.

General Electric, Sec. 666-14A, Schenectady, N. Y.

Yes, please send me:

- ☐ "How to Care for Motors" (GEA-2856A)
- ☐ Renewal Parts and Supplies (GEA-638)
- ☐ A supply of.....Motor Record Cards (GES-1526A)

Name .....

Company .....

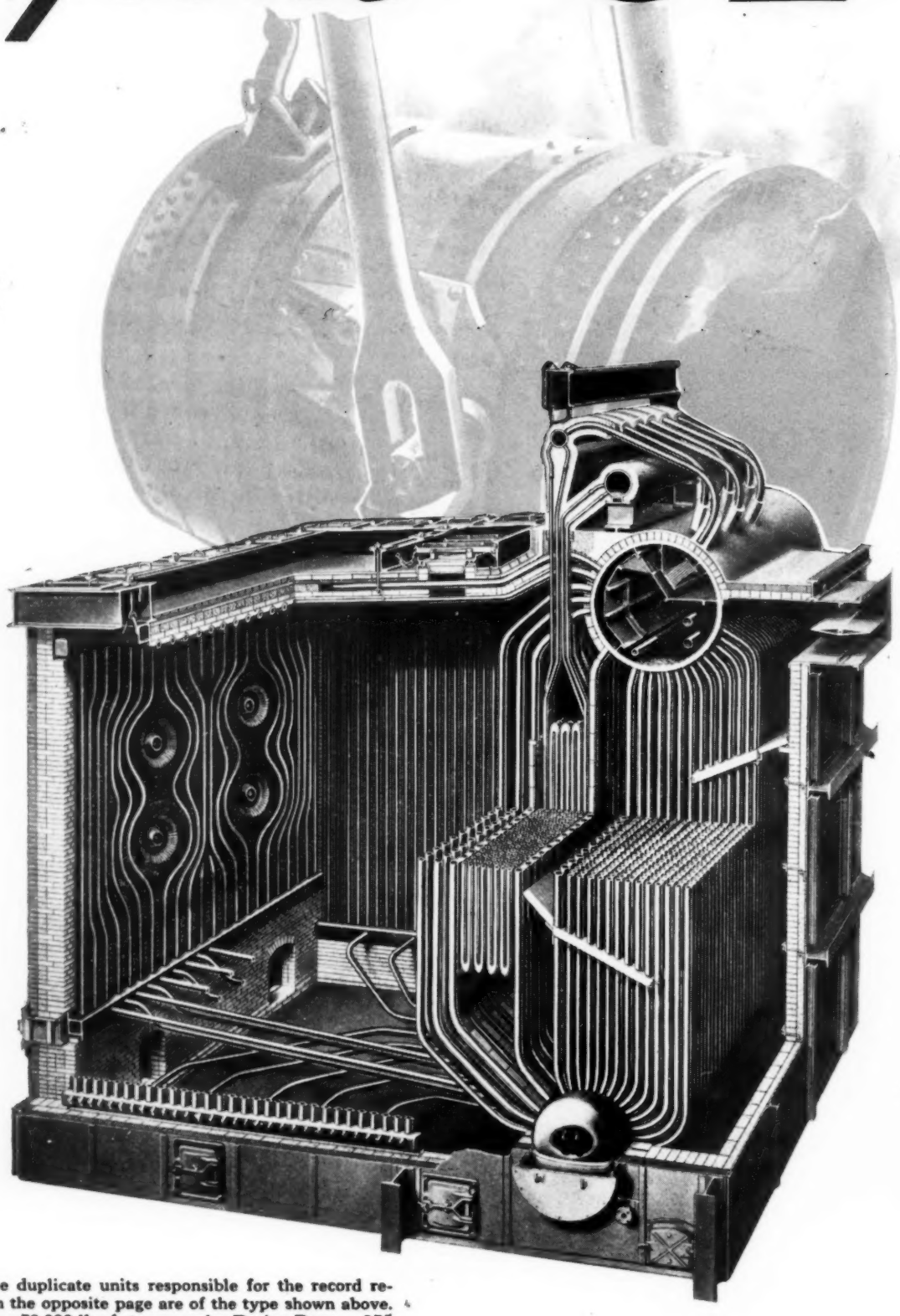
Address.....

City ..... State.....

*The best investment in the world is in this country's future—*
*BUY WAR BONDS*

**GENERAL ELECTRIC**

# Three C-E



The three duplicate units responsible for the record reported on the opposite page are of the type shown above. Capacity – 72,000 lb of steam per hr. Design Press. – 375 psi. Steam Temp. 450 F.

# Victory Units *

## step up output to supply greatly increased steam demand of big steel mill

During the 12 months ending August 1, 1943, the tonnage shipped by a prominent steel mill was nearly double that contemplated when its three VU Units were installed. The following data show how these units responded.

### CONTINUITY OF SERVICE

Combined use factor of all 3 units for the 12-month period, including regularly scheduled shutdown for check-up and maintenance – 92.5%. Combined availability – 96%. How well each unit carried its share of the increased load is evident from the following figures of hours in service for each unit during the year: 8,404; 8,408; 8,410.

### CAPACITY RECORD

Designed for a maximum continuous capacity of 72,000 lb of steam per hr each, all 3 units have *averaged their maximum rate* over periods as long as a month and have considerably exceeded it for shorter periods.

Thus the extra values inherent in C-E design and construction are demonstrated once again by the fine performance of these VU Units. The same type of performance repeated in many different *war* plants has abundantly proved the excellence of the VU design for meeting every demand with consistent dependability. This quality of performance can be assured for your *peace-time* steam needs by specifying C-E. A-768

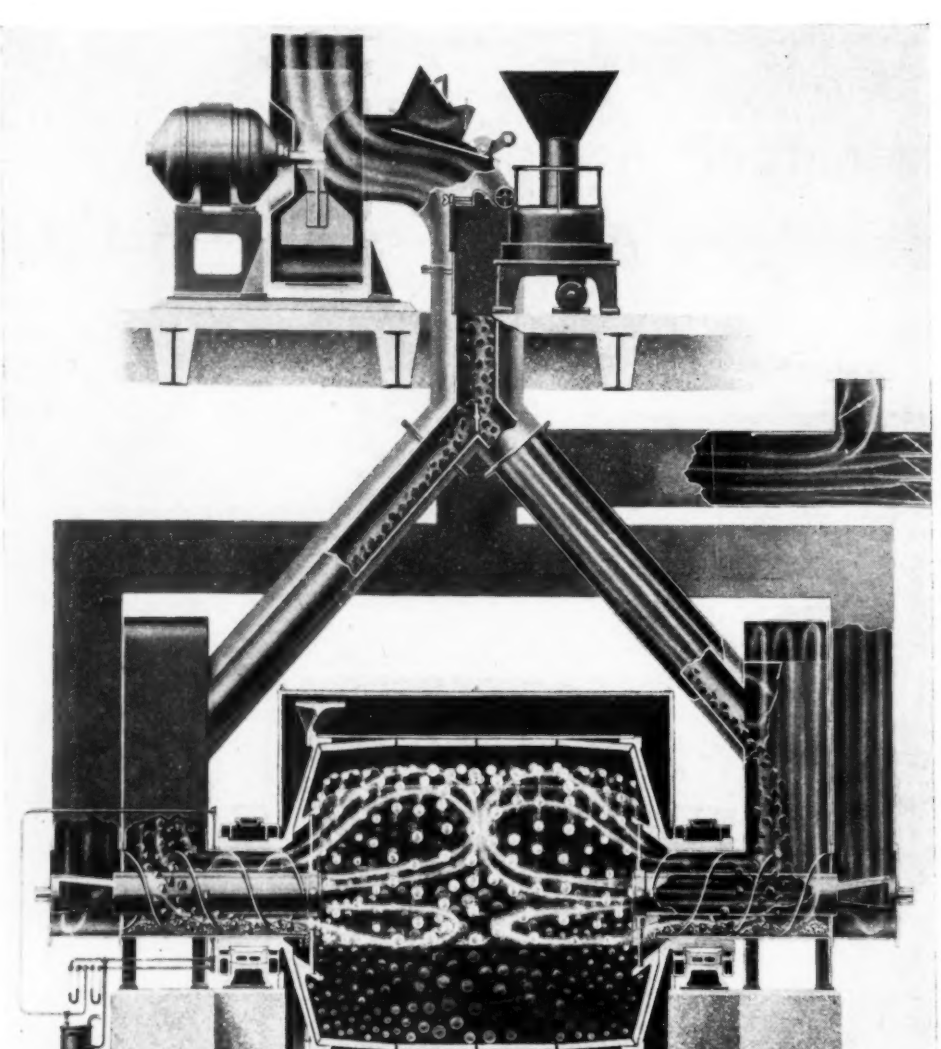
* Labelled The Victory Unit many months ago by a member of our Engineering Department who was impressed by the number of these units going into war plants.

COMBUSTION ENGINEERING

200 MADISON AVENUE NEW YORK 16, N.Y.

*Canadian Associates:* COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver

# *Continuous* FINE GRINDING



**Fine grinding and Full Capacity are obtained without dependence on close clearances between moving parts.**

**New Ball charge (the grinding medium) is added during operation as necessary, thus eliminating shut-downs to replace the pulverizing parts.**

FW **FOSTER**

# of PULVERIZED FUEL ASSURES LOWER COST STEAM

The outstanding performance characteristic of Foster Wheeler (Hardinge type) Ball Pulverizers is maintenance of high fineness in the pulverized fuel—over long periods of service without loss in capacity.

This exceptional ability to operate without reduction in fineness or forced outage, effects material savings including:

1. Boiler efficiency maintained for duration of run with resultant low cost for fuel.
2. Boiler outages for cleaning heating surfaces reduced; pulverizer repairs minimized.
3. Labor charges against cleaning boiler and water wall surfaces sharply decreased.

**FOSTER WHEELER CORPORATION,** **165 Broadway, New York 6, N. Y.**

**WHEELER** FW

*—then he said to himself*

# "The LIE is my political weapon"

At the start of his activity, Adolph Hitler proclaimed to the world that his weapon was the LIE

—the all-out undiluted LIE

—and now see what happens to a structure founded on bosh:

(a) the theory of the blitz *blasted*

(b) the legend of invincibility *exploded*

(c) the infallibility of his "intuitions" *fizzled*

He could have fooled a lot more people for a lot longer time, if he had only tried the trick of nursing along old truths—now turned into fallacies—but still adhered to by the unthinking majority.

For *Progress* has a way of flipping the FACTS of yesteryear into FLOPS almost overnight. The follower of an OUTDATED fact may easily find himself nursing a progress-blocking FLOP.

# *Here, Adolph,* are samples
## of yesteryear FACTS now turned FLOPS

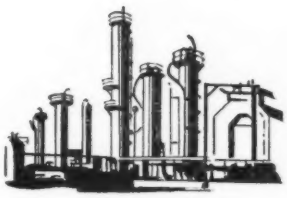
***FLOPPED FACT 1:***
**"You can't produce all-welded ships" . . . . . .**

....Recourse to arc welding has filled the seven seas with them.

***FLOPPED FACT 2:***
**"You can't arc weld high-temperature, high-pressure piping" . . . . . .**

....The one safe way is through recourse to arc welding.

***FLOPPED FACT 3:***
**"You can't weld cracking stills" . . . . . .**



....Without recourse to arc welding—our armed forces would be without high octane gas.

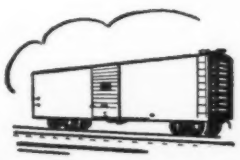
***FLOPPED FACT 4:***
**"You can't produce army tanks with arc welding" . . . . . .**

....Through recourse to arc welding—it's the only kind they're producing today.

***FLOPPED FACT 5:***
**"You can't erect buildings by arc welding". . . . . .**

....Savings in steel and money are represented in thousands of structures of every type—through recourse to arc welding.

***FLOPPED FACT 6:***
**"Railroad cars are taboo for arc welding". . . . . .**



....Watch them rolling the rails in every state—through recourse to arc welding.

**THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO**

*America's greatest natural* **recourse**

# ARC WELDING

# THE UNIT TANDEM

•

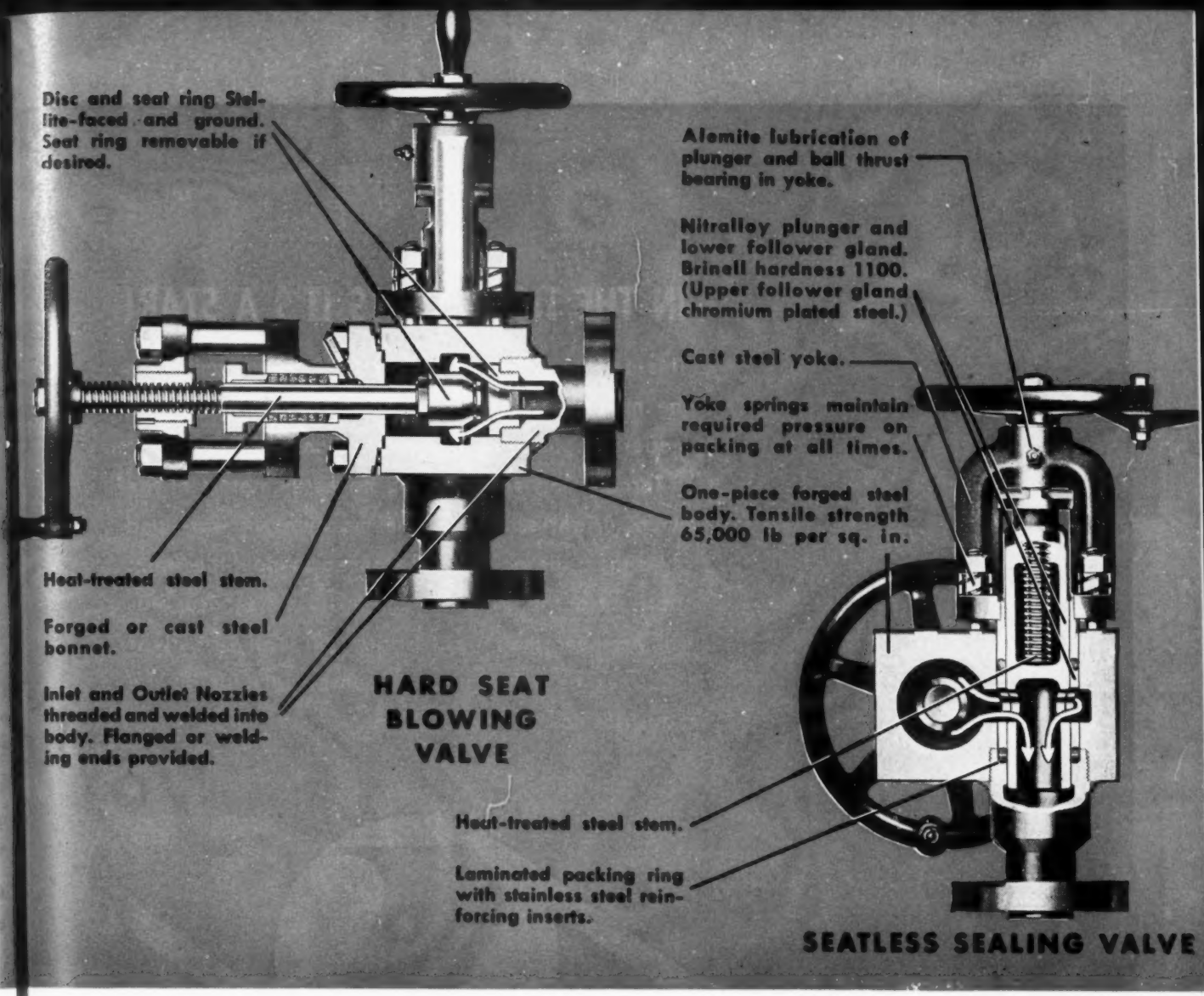
## Yarway's Finest Blow-Off Valve for the Highest Pressure Service

Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs — for blowing and for sealing — in a compact, rugged unit.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last, maintaining a tight seal at all times.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special alloys and unique construction features to reduce materially normal wear in this type of valve.

YARWAY


Disc and seat ring Stellite-faced and ground. Seat ring removable if desired.
Heat-treated steel stem.
Forged or cast steel bonnet.
Inlet and Outlet Nozzles threaded and welded into body. Flanged or welding ends provided.
HARD SEAT BLOWING VALVE
Alemite lubrication of plunger and ball thrust bearing in yoke.
Nitralloy plunger and lower follower gland. Brinell hardness 1100. (Upper follower gland chromium plated steel.)
Cast steel yoke.
Yoke springs maintain required pressure on packing at all times.
One-piece forged steel body. Tensile strength 65,000 lb per sq. in.
Heat-treated steel stem.
Laminated packing ring with stainless steel reinforcing inserts.
SEATLESS SEALING VALVE

# A Quarter Century of Product Development

Years of service in the high pressure plants of leading Utilities and Industrials have proved the soundness of design and metallurgy of the Yarway Unit Tandem.

Such records as—"3000 blows at more than 1300 lb pressure, without replacement of a single part or repairs of any nature"—have made this Tandem the outstanding preference for high pressure service, today.

Good boiler engineering demands equally sound engineering in the accessories that become part of it. It is not only protection for your investment, but cheap insurance against trouble and expense. The reason why most people specify Yarway Blow-Off Valves.

What are your draining or blow-down requirements? Write for Catalog. Section B-431 for pressures up to 2500 lb; Section B-422 for lower pressures.

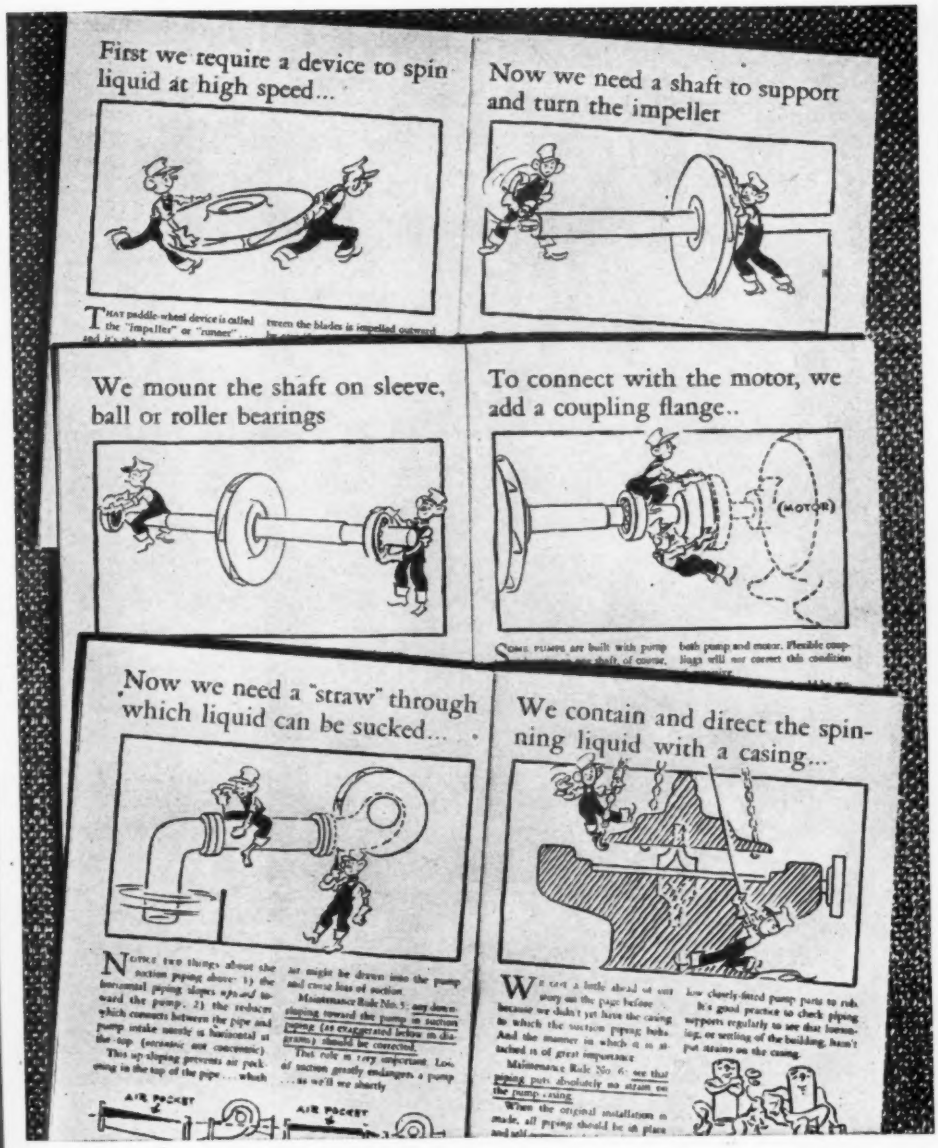
YARNALL-WARING COMPANY
100 Mermaid Ave., Phila. 18, Pa.

# BLOW-OFF VALVES

IN THE TIGHT SPOTS IT'S A STAR!
This new and distinctive Star trademark symbolizes the modern electric motor. Symbolizes, too, Star's modern engineering and production service.
Through this service, Star makes its motors fit the actual "tight spots" of the machines of war—and gives them the power and stamina to meet the "tight spots" of battle. And through this same service, Star will engineer the "tight spots" of many postwar industries as it has done so successfully for all the industries now served by Star.
STAR
POWER PACKAGED AS YOU NEED IT

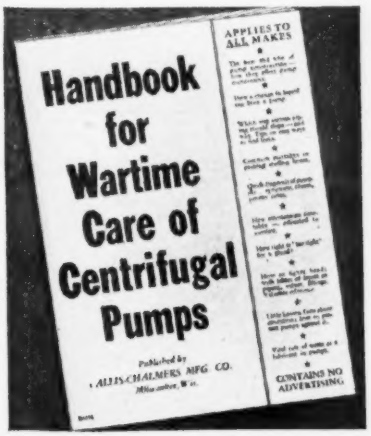
STAR ELECTRIC MOTOR COMPANY, BLOOMFIELD, N. J.

# Let's Build a Pump!


First we require a device to spin liquid at high speed...
Now we need a shaft to support and turn the impeller
We mount the shaft on sleeve, ball or roller bearings
To connect with the motor, we add a coupling flange..
(MOTOR)
Now we need a "straw" through which liquid can be sucked...
We contain and direct the spinning liquid with a casing...
AIR POCKET
AIR POCKET

**A PUMP IS BUILT—STEP BY STEP—IN A-C'S NEW PUMP MAINTENANCE GUIDE. AS EACH NEW PART IS ADDED, WE SEE WHAT IT DOES, HOW IT DOES IT, HOW IT MUST BE CARED FOR.**

WITH MOST PUMPS today doing *3 and 4 times* their normal work, they need the finer kind of care set forth in Allis-Chalmers' new "Handbook for Wartime Care of Centrifugal Pumps". Every executive, engineer and maintenance man should have a copy of this informative book in his technical library!




This book applies to *all* makes of pumps — contains no advertising! Contents include: new preventive maintenance tips; *war* timetable for pump care; valuable tables, etc. Tear out coupon and send in now for your *free* copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

Gentlemen:

Yes, I would like to receive, *free of charge*, a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name)

(Title)

(Company)

(Street Address)

(City and State)

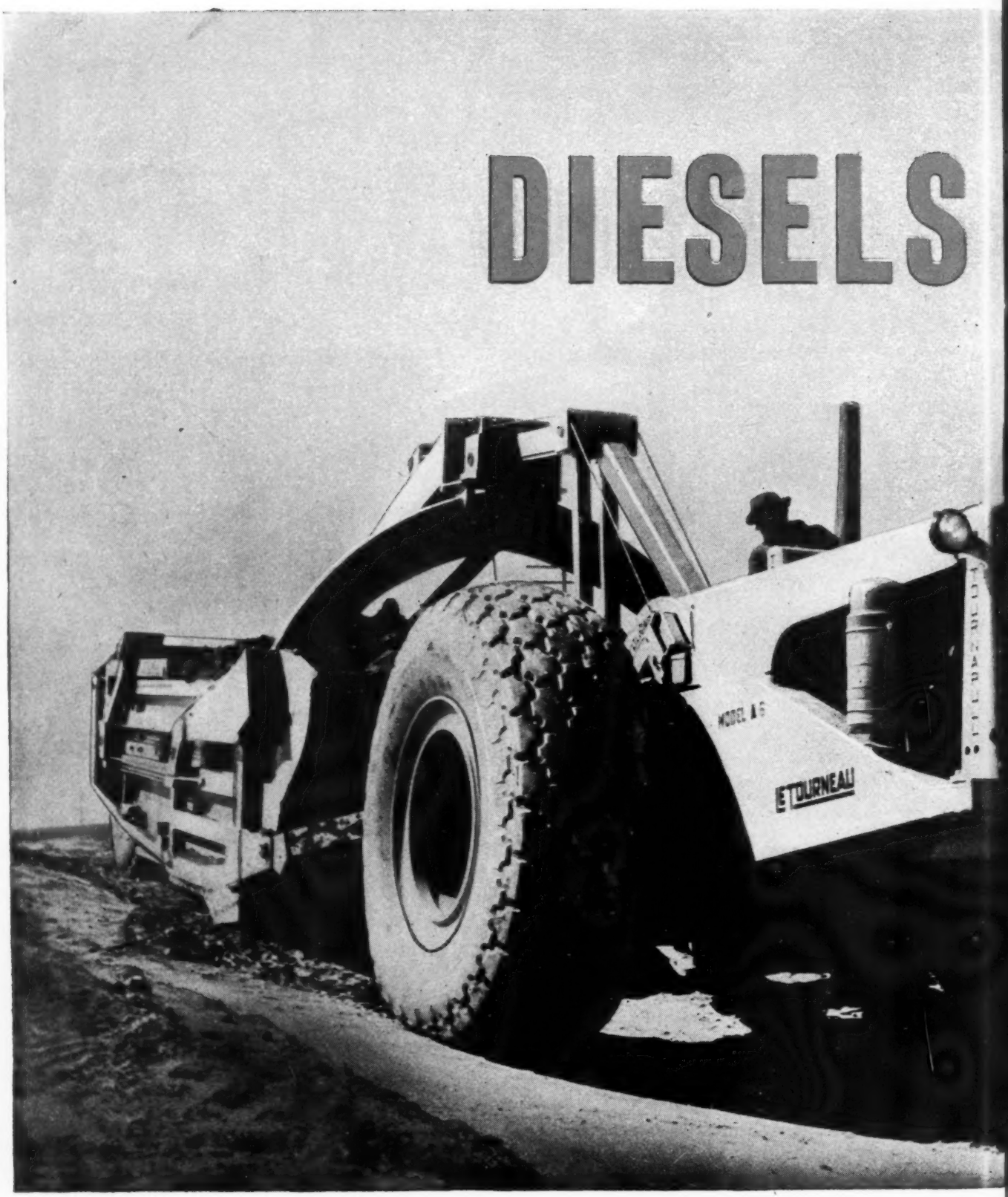
A 1653-9

*When you do need new pumps* — look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps... the famous "Electrifugal"... and all types for every purpose.

**ALLIS-CHALMERS MILWAUKEE**

WE WORK FOR VICTORY — WE PLAN FOR PEACE

# DIESELS

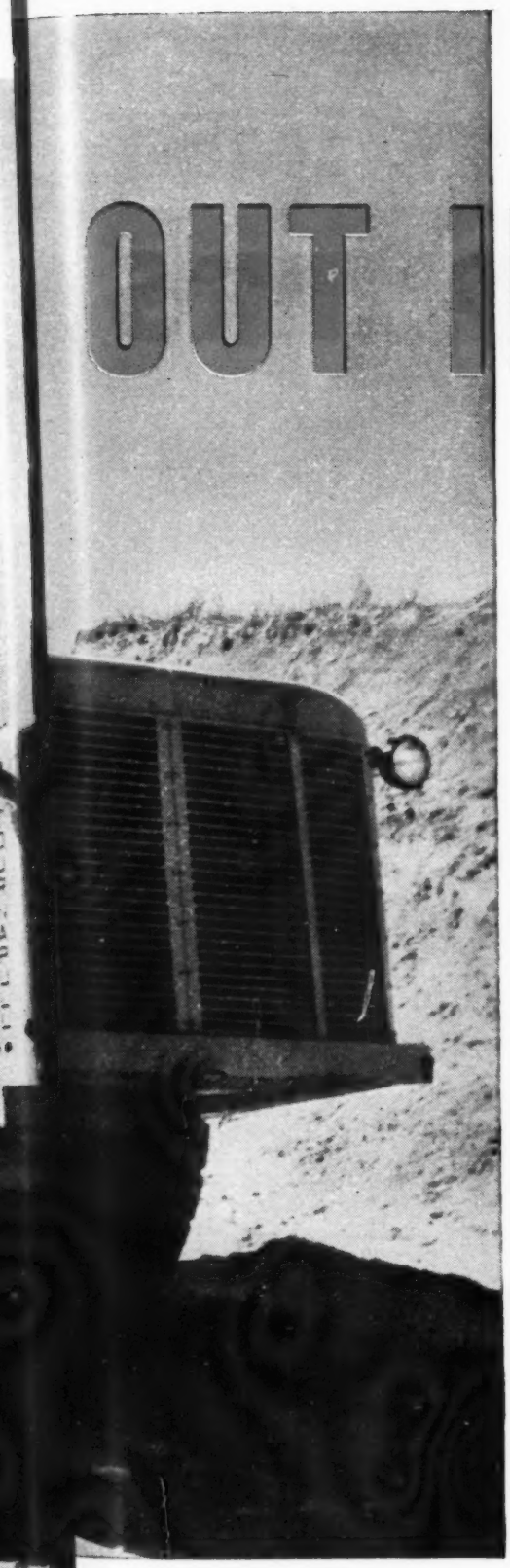



TEXACO

REG. T. M.

# TEXACO

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS



# OUT IN FRONT!

IN the Solomons, building airports . . . road construction on Attu . . . in tanks, trucks, landing barges. For rugged power on all battlefronts, it's Diesels.

Out in front, too, are the large stationary and marine Diesels . . . delivering power to war plants, lighting plants, pumping stations and vessels of all types. To assure maximum efficiency of Diesels in all services, more and more operators are lubricating with Texaco.

*Texaco Algol* or *Ursa Oils* increase life of rings, pistons, liners and bearings, keep rings free in their grooves, valves active, ports clear, assuring piston seal that means full power and maximum fuel economy.

Because of Diesel operators' success with them—

*More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

Texaco Lubrication Engineering Service is available to you through more than 2300 wholesale distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

# Lubricants and Fuels

## FOR ALL DIESEL ENGINES

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

# Coal Conservation
# DETROIT STOKERS

WAR DEPARTMENT
DETROIT ORDNANCE DISTRICT
1832 NATIONAL BANK BUILDING
DETROIT 32 MICHIGAN

1 November 1943

TO INSURE PROMPT ATTENTION
IN REPLYING REFER TO
Det. Ord. No. 675/2210
ATTENTION OF

Detroit Stoker Co.
Monroe
Michigan

Gentlemen:

The War Production Board is sponsoring a broad conservation program to conserve coal, petroleum products, transportation, electricity, water, manufactured and natural gas, and communications. Newspapers, magazines and the radio are being used to advertise the necessity for eliminating all waste and unnecessary use of these vital commodities.

The Ordnance Department is interested in extending every possible cooperation in this effort and would like to urge that your company, as a producer of Ordnance Materiel, do everything it can to help in this worthwhile campaign. This will not only assist in the War Effort, but undoubtedly will also effect actual savings in your operating costs. Although the savings in a single home or plant may seem small, the possible aggregate savings nationally are tremendous in terms of manpower, fuel, material and equipment, all of which are vitally needed in war production.

Yours very truly,

A. B. Quinton, Jr.,
Brigadier General, U. S. A.,
District Chief.

**A letter from the War Department on the subject of Coal and Fuel *Conservation*.**

**Every possible effort must be made to conserve fuel. Conservation makes worthwhile savings in operating costs.**

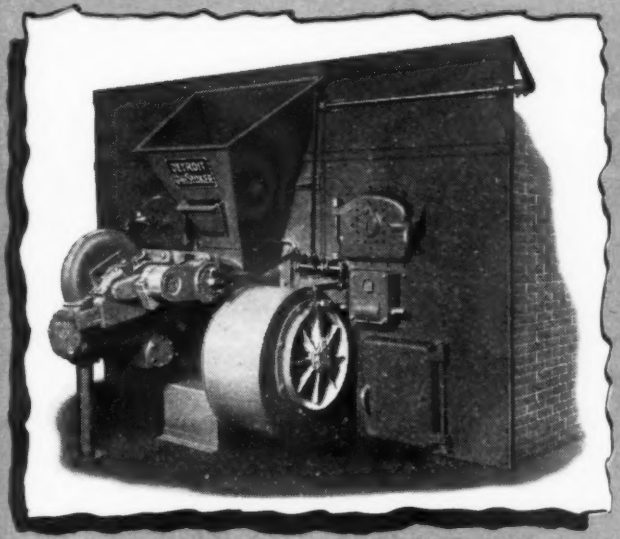
**One of the best ways of conserving fuel is right under the boiler—by improving the *combustion*.**

**Detroit Stokers have a long record of fuel economy in all kinds of plants.**

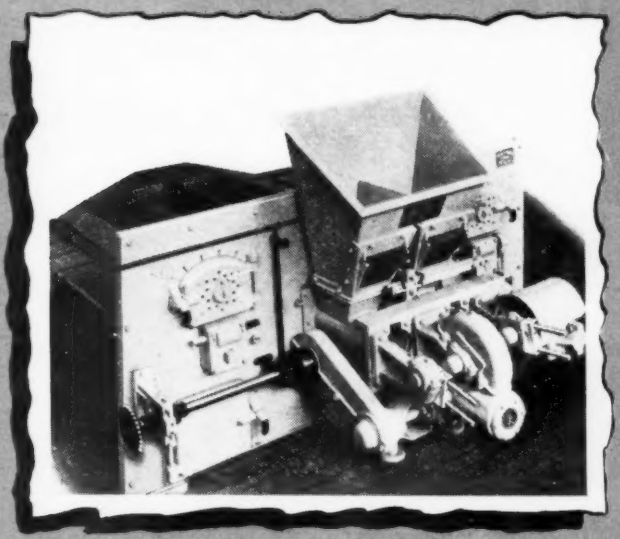
**They have an exceptional reputation for dependability. Write us for our recommendation. Ask for Bulletin 530.**

# is a Vital Need...

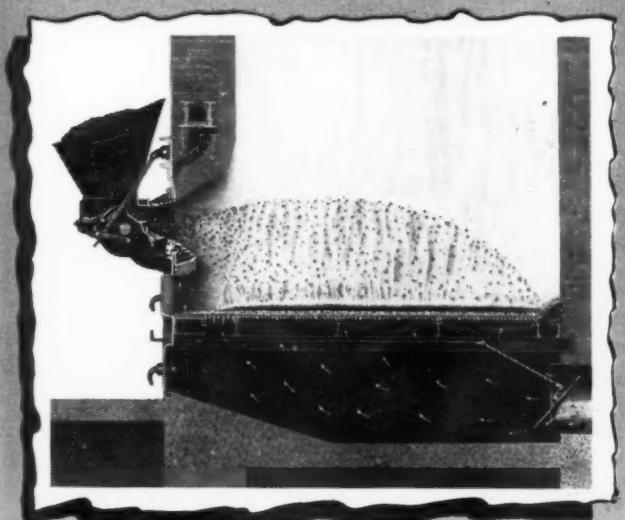
# CONSERVE COAL



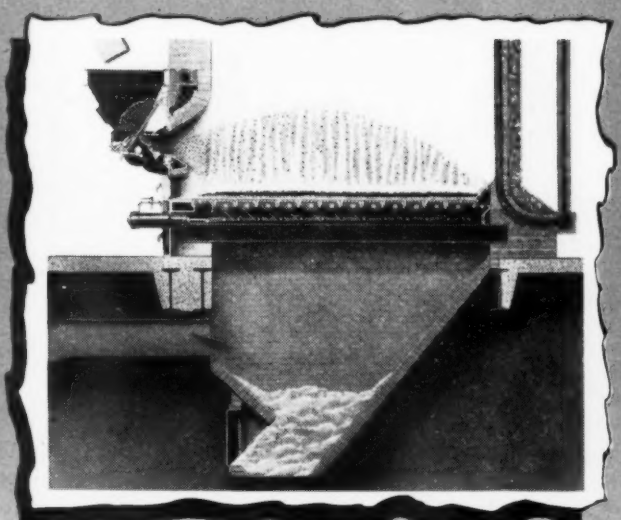
**DETROIT UNISTOKER**—(With Detroit Adjustable Feed) Single Retort, mechanically driven, unit type, operated by either electric motor or turbine. For 125 to 300 Horsepower Boilers.



**DETROIT DOUBLE RETORT STOKER**—Multiple Retort Stoker having two Retorts, with the side cleaning feature. Built in several sizes, for boilers having wide furnaces.



**DETROIT ROTOSTOKER** (Stationary Grate Type) Spreader Stoker. Burns fine coal in suspension, coarser coal or refuse on the grates. Overthrow Rotors insure uniform fuel distribution. For medium boilers.



**DETROIT ROTOSTOKER**—(Power or Hand Dumping) Over-throw Rotors and even distribution. Discharges the ash into the pit or basement below. For medium or large power boilers.

**DETROIT STOKER COMPANY** General Motors Bldg. Detroit, Michigan

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

# DESIGNING A HEAT-TIGHT WALL

It takes more than materials to design a heat-tight wall although each must be selected on the basis of their outstanding function — *refractories* for protection against the furnace gases; *insulation* to stop the flow of heat; *cast-iron members* for sectional support, and a *plastic* material, applied with a trowel, to provide a permanent, weatherproof casing

It takes more than merely tying these four elements together although they must be so integrated that they will function as a single unit, yet allow enough flexibility to provide for wide ranges of temperature.

What it takes is the know-how that comes from first-hand knowledge—knowledge acquired over thirty years of engineering heat enclosures. And it's Detrick that has had this long background of experience.

A new 80-page catalog presents the Detrick principles of construction which have been learned the hard way, in a graphic form which will bring any engineer up to date on the important subject of heat enclosures. If you have a problem along these lines up at present or contemplate one in the future, send for your copy today.

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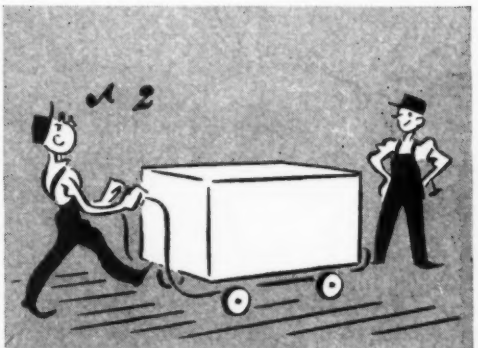
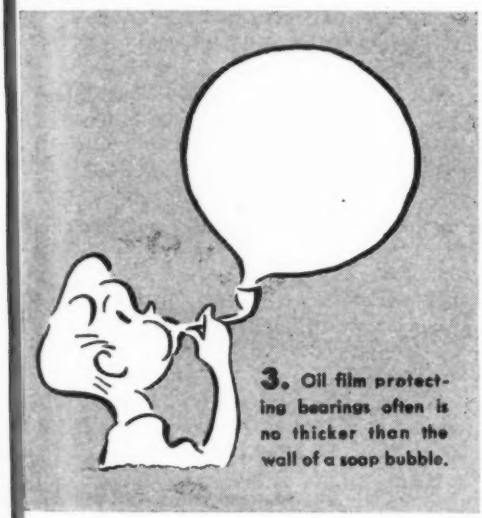
## It's Electric Motor Enemy No. 4...

In Allis-Chalmers' new "Guide to Wartime Care of Electric Motors".

1. Like a motor without oil. Simple! Yet every day hundreds of workers overlook the importance of adequate motor lubrication.

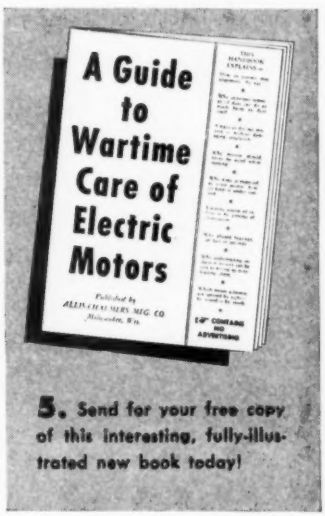


2. Like a motor with oil. Pictures like these make motor maintenance easy to put across in training new employees.



3. Oil film protecting bearings often is no thicker than the wall of a soap bubble.

4. And if pressure is too great, the film can fail just as suddenly and completely.




5. Send for your free copy of this interesting, fully-illustrated new book today!

ONE OF A MOTOR'S most dangerous enemies is friction. In peacetime, instructions for guarding against it were based on 8-hour-day, 6-day-week operation. Today, with motors working up to *3 and 4 times* as many hours a week, those instructions are dangerously obsolete!

To help put U. S. motor maintenance on an efficient wartime footing, Allis-Chalmers has published "Guide to Wartime Care of Electric Motors". This valuable book explains the *9 main enemies* of electric motors . . . tells you how to fight them. Its recommendations are simple and practical . . . ideal for training new men or as a review for experienced men. Book is fully illustrated with stimulating, understandable sketches like those shown above—*contains no advertising*. Over 100,000 copies in use by industry and armed forces. Send for your *free* copy today! ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

A 1658

## ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC

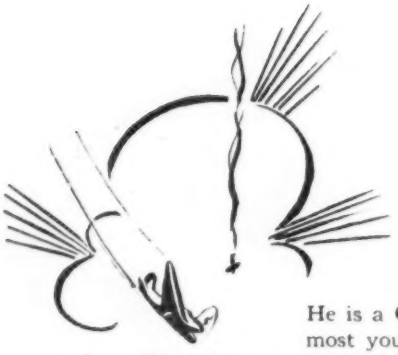
WE WORK FOR VICTORY

WE PLAN FOR PEACE

# ONE OF THEM

*Written Specially for the*
*Allen-Sherman-Hoff Company*
BY

## Lowell Thomas



He is a Captain at an age when most youngsters are just leaving college, West Point or Annapolis. Moreover he is Captain in a Corps whose standards are mercilessly exacting. Most Marines don't reach that rank until they are in their thirties. This one has been in the service only two years.

There is nothing spectacular about his looks or manner. He is a slim, diffident lad of medium height, brown hair and blue eyes.

After a year and a half as a Marine there still was nothing spectacular about his career either, although he had proved to be an interceptor pilot competent enough to be leader of patrols. But in April, 1943, the whole country rang with the exploit of Captain Zeke (James Elms) Swett, U.S.M.C.

On the afternoon of April 7th he had finished leading his patrol in its second flight of the day over the island of Tulagi in the Solomons. The Japs were doing their utmost to blast us out of there and Guadalcanal. Just as they landed for the second time in a day, the reconnaissance reported a big formation of Jap planes heading south for Tulagi. Swett was sent up again.

At 16,000 feet he heard an excited yell through his earphones:

"There's millions of the ********s there over Esperance."

Swett and his group headed for Cape Esperance at four hundred miles an hour. A flight of Jap Zeros hopped them on the way but the Marines dodged and ignored them. Their target was a huge force of Aichi dive bombers blasting the U. S. shipping in Tulagi Harbor. Swett caught one of them just as he was going into his dive, bomb all ready to drop. He squeezed the button on his stick just twice. The Aichi plane began to smoke, burst into flame and exploded in mid-air. Jap No. 1 for Swett.

He caught up with another enemy bomber. Two more squirts from his .50 calibre guns and another Aichi exploded in the air. Jap No. 2.

Then Swett spotted a third just over him. He nosed up at terrific speed and was caught in the bomber's slip stream. His own plane wobbled dangerously but he held


A-S-H

**Here is another short story that has to do with our own experience. . . . Quite recently we were called to study the handling of certain materials in two metal-producing plants and in answer to their questions we assured them that the material they were asking us to handle was much easier to cope with than the material we were already handling in Power Stations. We came back and talked it over with 'Ole Hydrojet and 'Ole Hydrovac, who said they honestly never knew what material went through them; that they didn't care; and that they would work just as well in a Steel Mill or Aluminum Plant as in Power Stations—just give them the chance. We did, and they came through.**

# MARINES

on and let go with tracers into the Jap's fuselage. By this time they were over Tulagi Harbor. Fragments of the exploding bomber rained on Swett's engine and there was Jap No. 3.

The Marine Captain was now only 800 feet above the water. As he pulled back on the stick to go upstairs, a Jap slug blew a hole in his left wing the size of a cabbage and smashed one of his guns. Swett made for the other side of the island, hedge-hopping over the jungle and hid in a rain squall. As he flew out of it, there ahead of him were five of the Aichi dive bombers returning home at leisurely speed. He took first the one on the extreme right. "I couldn't miss," he explained later and Swett's Jap No. 4 was in the bag.

The next two, he said, were easy. "Just a little fire, then a big one, like a marshmallow bonfire!" But the last one nearly got Swett. To get on the enemy's tail he gave the bomber's rear gunner a pointblank shot. It splintered Swett's windshield and cut a gash in his nose. But he had bagged Jap No. 7. That made the score seven Japs in fifteen minutes. Four of them with one gun out of commission.

He was now in bad shape, ammunition gone, oil leaking. His prop stopped dead and he had to make a water landing. After a struggle to get out of his harness, he managed to inflate his life raft.

He floated around until he spotted a navy patrol boat and fired a signal. The boat tore over towards him. As it approached he saw, nervously, two .50 machine guns and four rifles trained on him.

"Are you an American?" shouted the Navy coxswain.

"You're goddam right I am," yelled Captain Zeke Swett. That identified him!

"It's all right," said the coxswain to his crew: "It's one of them Marines, pick him up."

On the strength of this fifteen-minute party, his commanding officer recommended Swett for the highest of all awards, the Congressional Medal of Honor. At this writing he has not yet received it. But three months later he won the Purple Heart.

On July 11, 1943, Captain Swett and Lieutenant Harold F. Segal tangled up with a formation of seventy Jap planes. Both men were shot down but not until each of them had bagged three Zeros apiece. The Japs followed Swett down to water level, strafing him with machine gun bullets all the way. After he hit the water they kept after him. He didn't even have a chance to inflate his Mae West. Fifteen minutes at a time he spent diving and coming up for a breath of air until his lungs almost burst. But finally he managed to climb back into his plane to get his rubber boat and inflate it.

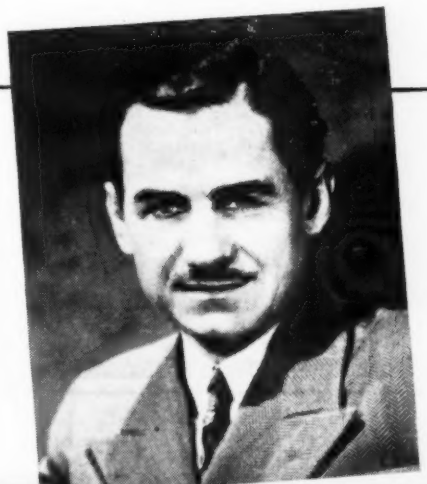
He paddled his way to New Georgia Island and slept on a coral beach, wrapped in his parachute. Next day he paddled along the coast, to one deserted village after another, until he found two friendly natives who guided him to the nearest American base.

James Elms Swett is twenty-three years old. Graduating from Junior College at San Mateo in 1941, he enlisted in the Marines four months before Pearl Harbor. He graduated as Naval Aviator at Corpus Christi, Texas, took instruction in communications at Quantico, thence to San Diego and Pearl Harbor for final training on aircraft carriers. He is section leader in the Marine Corps and communications officer of his squadron.

"One of them Marines!" Not a bad description.

**WRITE FOR LOWELL THOMAS BOOKLET**

Following the publication of a few more of these Lowell Thomas stories, we plan to publish the entire group in booklet form. In order to help us decide on how many to print, we'd appreciate your writing us now, so that we can reserve a copy for you. No obligation, of course.



**LOWELL THOMAS,** who has been broadcasting the day-by-day adventures of mankind without interruption for the past thirteen years, has had a varied and adventurous career. He was born in Ohio in 1892, reared in a Colorado gold camp, and has lived all over the world. As a young man he was a gold miner and cow puncher. Then he turned to newspaper work as a reporter and editor. After attending and receiving degrees from four universities, he became a member of the faculty of Princeton University.

As a speaker—before his radio days—he probably appeared in person before more people than any other man in the history of the platform.

As a traveler, he has led expeditions into the far north, into the tropics, and across remote sections of Central Asia.

He is the most widely known of screen commentators, and for the past ten years has been the Voice of Twentieth Century-Fox Movietone, the newsreel that has the widest circulation.

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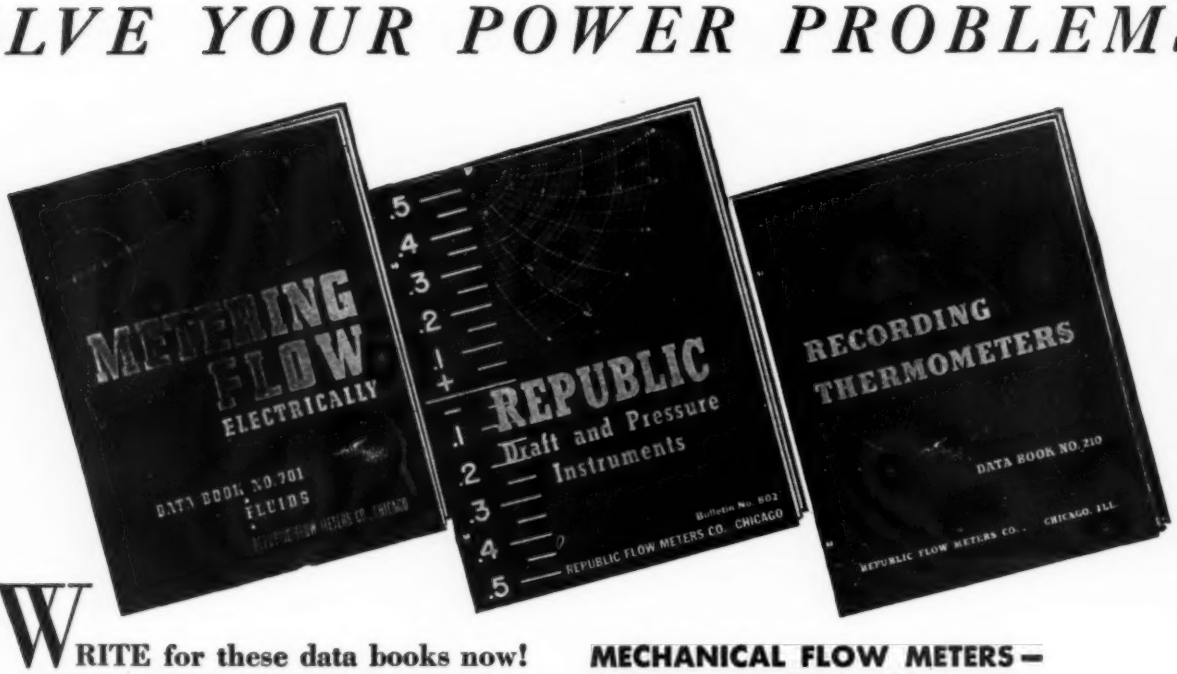



**WRITE for these data books now! They are filled with important power plant data generally difficult to locate. When your increased power load demands the installation of new units or the "stretching" of existing plant capacity, you will need this information.**

### REMOTE READING FLOW METERS — Data Book No. 701

For measuring flow of steam generated by each boiler and the total produced; steam consumed by prime movers and process steam consuming units; water supplied to boilers and pumped to processes; rate of generation, distribution and consumption of natural gas, coke oven gas, compressed air and the like; flow of fuel oil, brine, black liquor and so on; the Republic electrical type flow meter with remote reading instruments, as book, is available.

### MECHANICAL FLOW METERS — Bulletins No. 110 and No. 311

When it is desired to measure flow of steam, water, gas, air or oil for the same purposes as outlined above but where remote registration is not required, the Republic mechanical meters described in these books are available.

### DRAFT AND PRESSURE INSTRUMENTS — Bulletin No. 802

Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic indicators and recorders, described in detail in this bulletin, are supplied in any desired combination for all ranges encountered in furnace operation.

EQUIPMENT • FACILITIES • PERSONNEL • EXPERIENCE
REPUBLIC INSTRUMENTS AND CONTROLS

## RECORDING THERMOMETERS — Data Book No. 210

Measurements of temperature of flue gas, temperatures in vats or tanks, pipe lines, refrigeration systems, ovens, kilns or ducts and so on, are vital in maintaining highest capacity and efficiency in power plant and process equipment. Republic recording thermometers for this service are described in this data book.

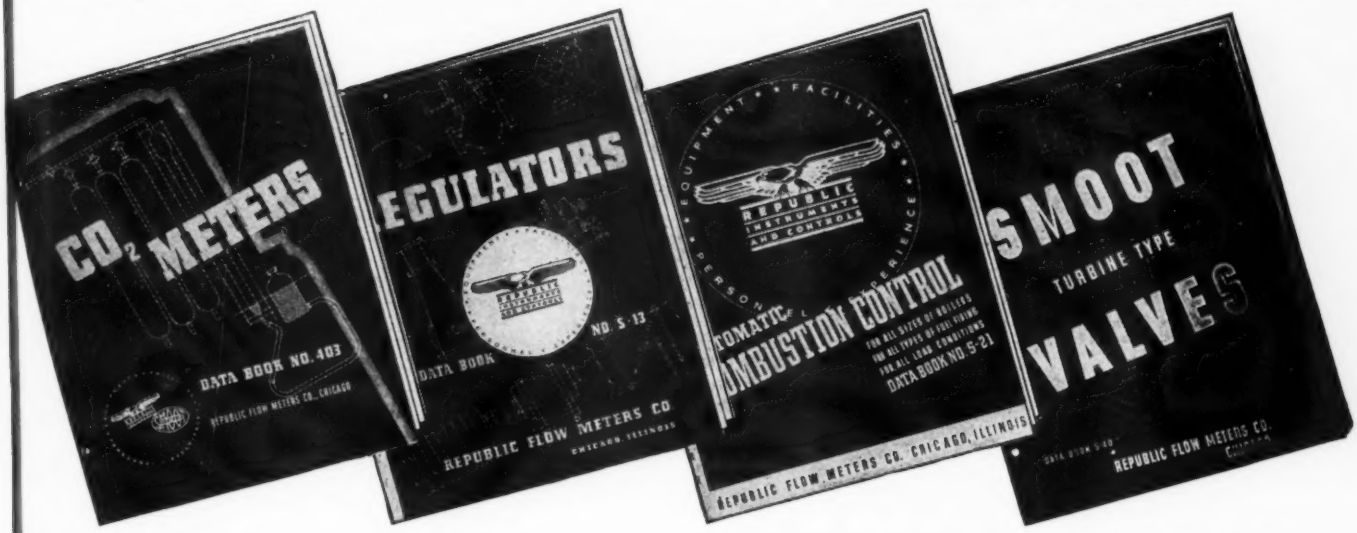
## $CO_2$ METERS — Data Book No. 403

For every fuel and boiler, there is a definite percentage of $CO_2$ in the flue gas that will assure highest combustion efficiency. The $CO_2$ meter is the most practical method of determining combustion efficiency. The construction and operation of the Republic $CO_2$ meter are described in detail in this book.

Republic-Smoot automatic combustion control systems are built for all sizes of boilers, all types of fuel firing and all load conditions, as described in this book, which includes detailed installation reports giving performance data on outstanding power plants.

## REGULATING VALVES — Data Book No. S-40

In any plant generating high-pressure, high-temperature steam, there are key valves doing tough jobs in controlling flows or pressures on which vital operations depend — pressure reducing valves co-ordinating high and low pressure steam systems, feedwater valves on 1500 lb. boilers. For such tough jobs, where responsibility, long life and accurate regulation count most and failure must not occur, the Republic-Smoot valves described in this bulletin have been designed.




## REGULATORS — Data Book No. S-13

Control of rate of flow of liquids and gases, level of liquids, speed of turbines, engines and motors and proportions between variable pressures and flows must be accurate if maximum plant efficiency is to be attained. These factors are controlled by operation of valves, dampers, rheostats, etc. For sensitive, fast, stable and powerful automatic control of these devices, the Republic-Smoot regulator has been developed. Its construction, operation and applications are described in this book.

## AUTOMATIC COMBUSTION CONTROLS — Data Book No. S-21

Boilers must produce maximum steam output at maximum efficiency. That means constant steam pressure, maximum combustion efficiency, constant and correct furnace draft, desired load division among boilers.

## DESUPERHEATERS — Data Book No. S-35

In the modern power plant, steam temperatures in interconnected systems — topping turbine bypasses, tie lines, turbine exhaust lines and process steam headers — must be accurately controlled by desuperheaters. For such exacting services, the Republic-Smoot desuperheaters described in this book are employed.

★ ★ ★ ★

**Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant. Your inquiries will involve no obligation on your part.**

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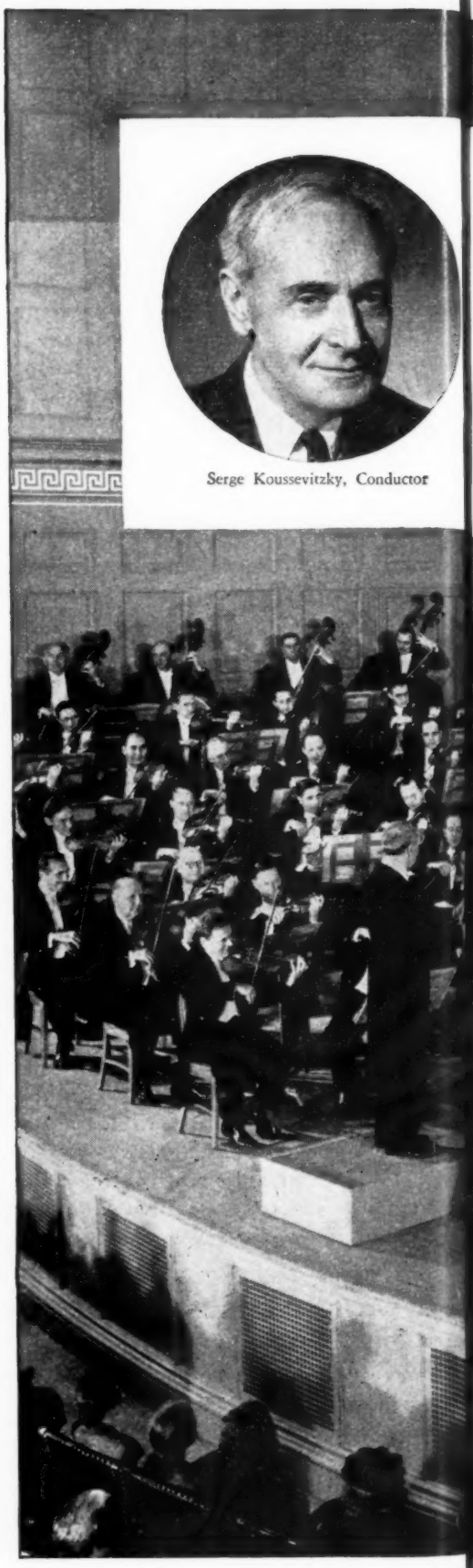

Serge Koussevitzky, Conductor

ENGINEERING THAT AIDS ALL INDUSTRY
HELPS FURTHER AMERICAN GOOD LIVING

# Allis-Chalmers invites Every Reader of this Magazine to tune in next Saturday and every Saturday thereafter

MUSIC — sister to every science and industry furthering Good Living — is Allis-Chalmers' choice of radio entertainment for America.

In the words of Serge Koussevitzky, world-famous conductor of the Boston Symphony itself: "Today American audiences show not only their love and admiration of music, but also a deep understanding of the necessity and importance of musical art in the progress of humanity."

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That is why we respectfully dedicate to *you,* the Men of American Industry, our radio sponsorship of the Boston Symphony.

Today over 1600 Allis-Chalmers products are helping America to the earliest possible Victory — *after the war,* the same engineering will mean Good Living, the American Way. ALLIS-CHALMERS, MILWAUKEE, WIS.

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# ALLIS-CHALMERS

# Simplicity of Design Means Easier Maintenance

**IT'S EASY . . .**
**TO GET TO THE WORKING PARTS**

Simply open the valve part way, unscrew union ring, and the complete assembly of working parts can be lifted from the body —for inspection, cleaning, seat and disc regrinding, or replacement of parts if necessary.

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. . . and it saves the valve, too, because regular servicing not only keeps the valve in top condition and gives it longer life, but it reduces the possibility of having to make extensive repairs later. The simplicity of Lunkenheimer design makes all parts easily accessible for checking any first signs of lagging operation, and the taking of precautionary measures.

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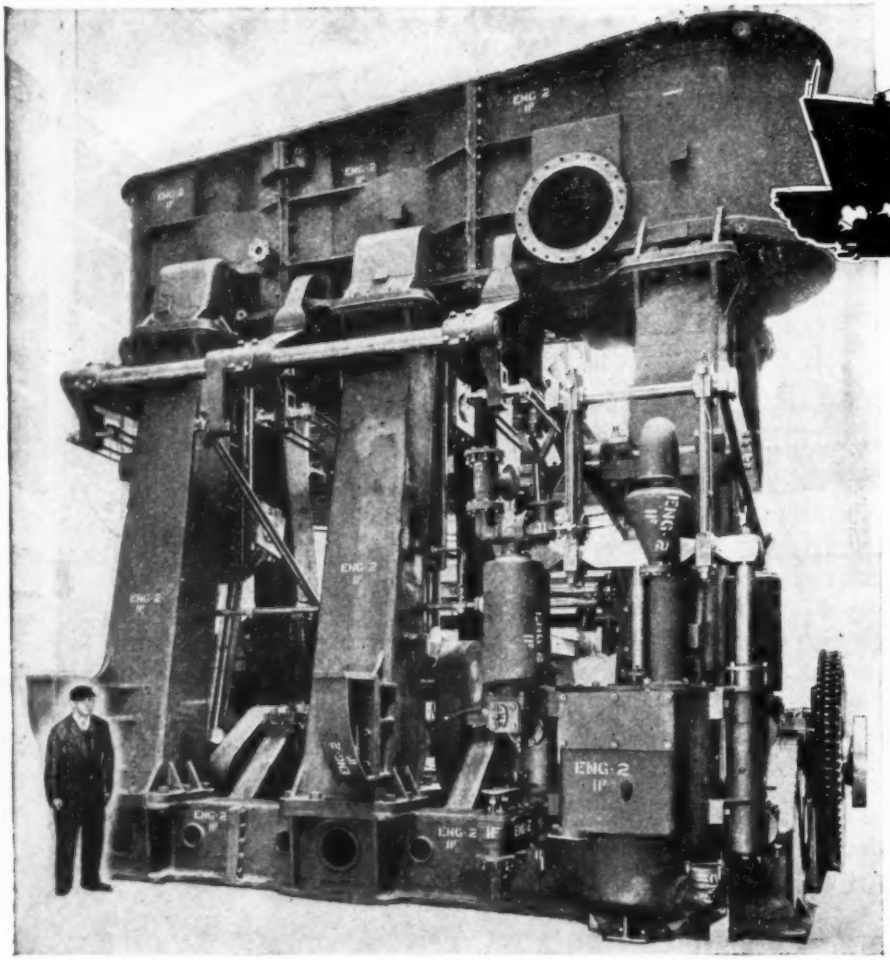
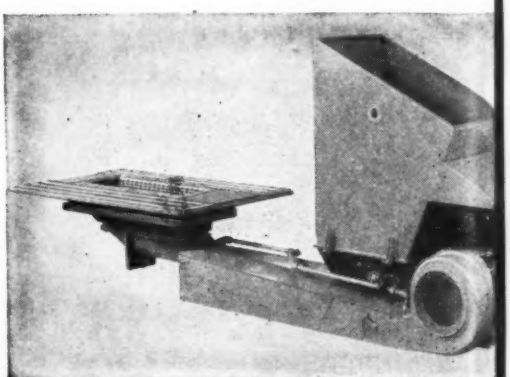
# IRON FIREMAN WAR
# Marine Engines



Notice size of Iron Fireman marine engine compared to man at left.

TWO months after Pearl Harbor, Iron Fireman was given an order for 2500 horsepower triple expansion marine engines for Liberty ships. More orders have followed and today Iron Fireman is one of the largest producers of these engines, with an output of 30 engines per month.

Iron Fireman engines weigh 270,000 pounds, have a stroke of 48 inches, with cylinders ranging from 24½ inches in diameter in the high-pressure-cylinder to 37 inches in the medium-pressure-cylinder and to 70 inches in the low-pressure-cylinder. Each engine contains 15,542 separate parts. These engines power the famous Liberty ships produced by Henry Kaiser and other shipbuilders.



## World's Largest Producer of Coal Stokers

Iron Fireman is the pioneer and world's largest builder of automatic coal stokers. Iron Fireman stokers are the standard of value in coal firing equipment. A national organization of factory-trained engineers and dealers is doing a tremendous job in installing and servicing stokers in power and heating plants throughout the country. Iron Fireman is operating three shifts a day building commercial heating and industrial power stokers to convert oil and hand-fired plants to automatic coal firing.

Iron Fireman stokers are engineered to burn efficiently all types and grades of coals. Our nationwide organization of qualified factory representatives and dealers is at your service. Write or wire the Iron Fireman Manufacturing Company, 3510 West 106th Street, Cleveland 11, Ohio. Plants in Portland, Oregon; Cleveland, Ohio; Toronto, Canada.

**IRON FIREMAN**

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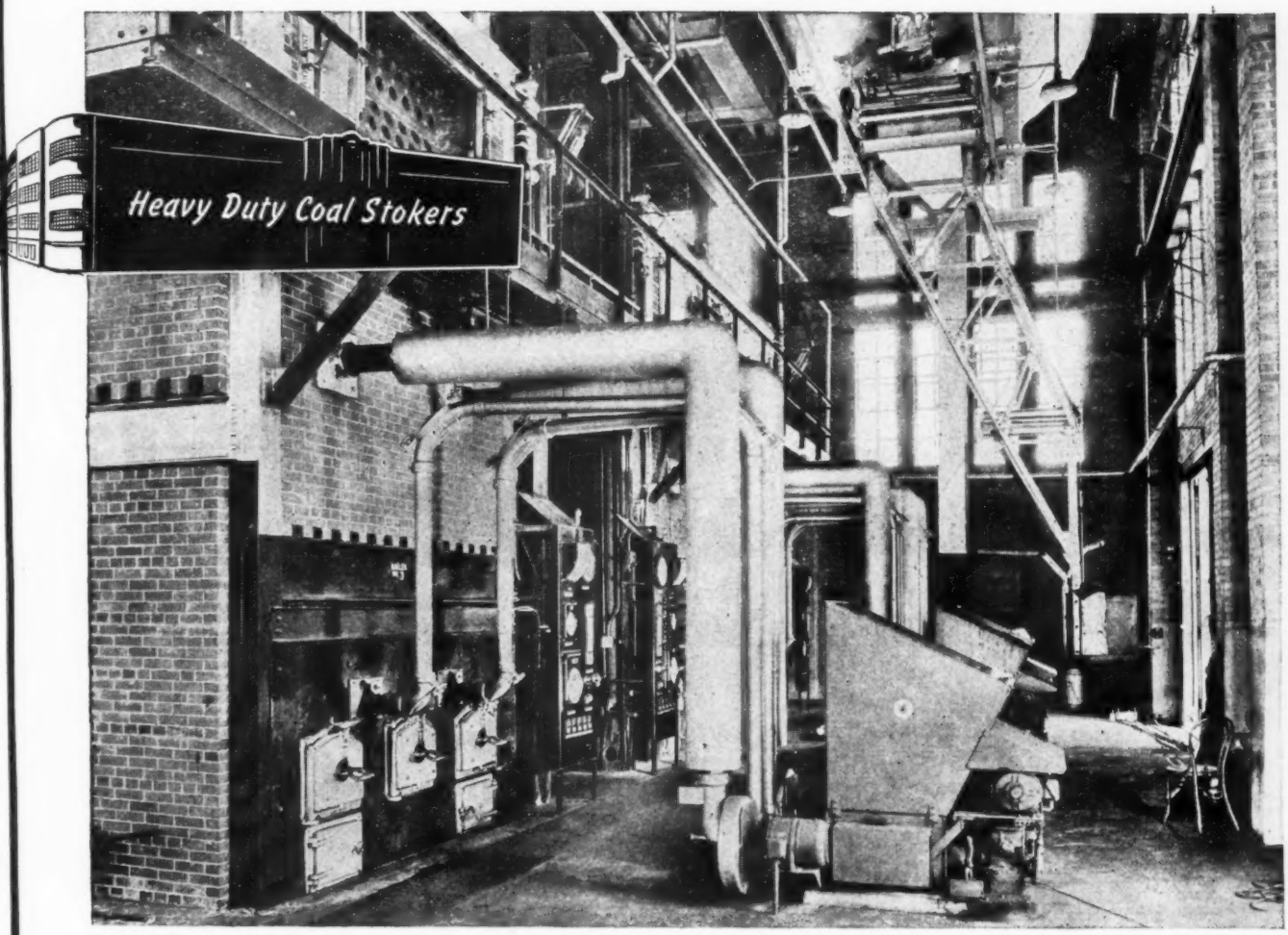
# WORK Includes as well as stokers




The dual nozzles of this Iron Fireman Pneumatic Spreader stoker convey coal to two boilers. Pneumatic Spreader stokers fire boilers developing up to 1,000 horsepower and larger.

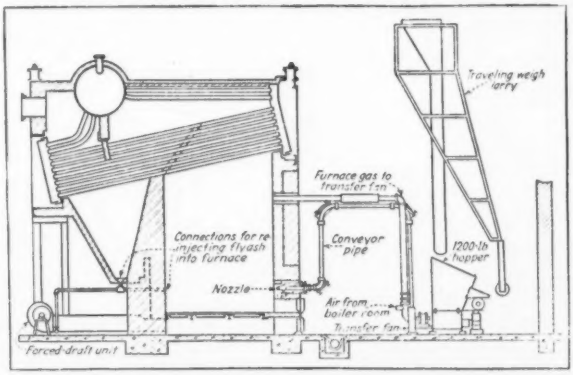
### Heavy Duty Poweram Underfeed Stoker

The Iron Fireman Poweram stoker, designed for heavy, continuous loads, combines *worm feed* with *ram distribution* of coal. The worm conveys the coal to the retort in a loose, aerated condition; reciprocating blocks distribute it evenly and prevent packing.

Illustration shows hopper model. Bunker-feed models also available, which feed direct from main bunker to fire, and eliminate coal handling.

### Iron Fireman Pneumatic Spreader Stoker

The Iron Fireman Pneumatic Spreader stoker conveys steam size coal from the hopper or main coal bunker to a transfer housing, where the coal is picked up by a stream of air and conveyed to the furnace or grates. The fines burn in suspension, utilizing the conveying air for combustion. The larger pieces form a shallow fuel bed on the grate. By means of an adjustable nozzle the coal is dropped by gravity and distributed uniformly over the entire grate area.

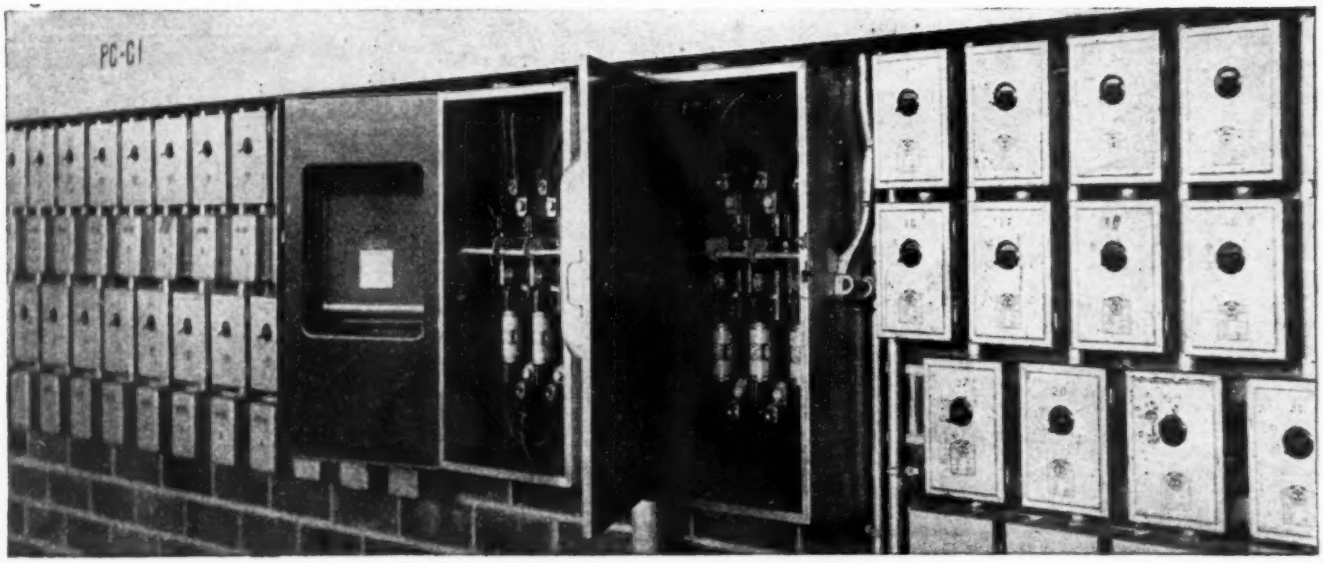



IRON FIREMAN

THE IRON FIREMAN

Marine Engines

Automatic Coal Stokers



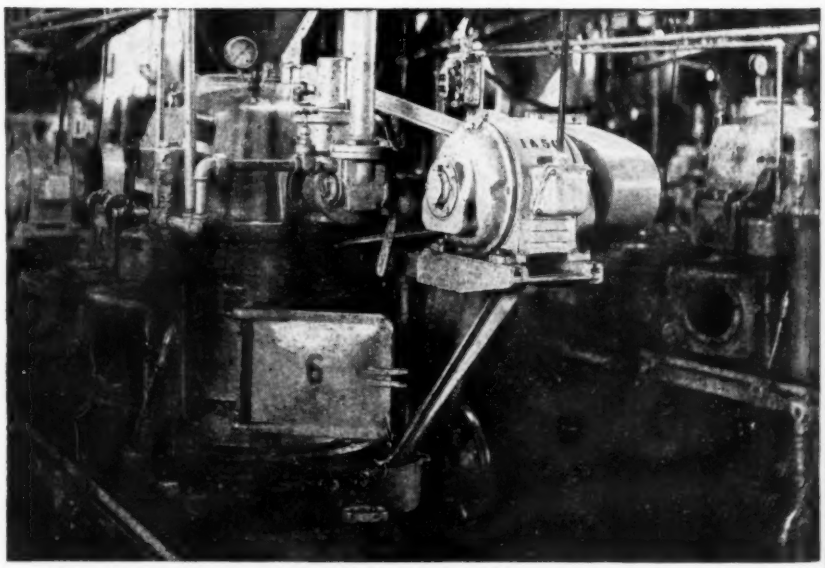

*BUSS Super-Lag fuses are used in feeder and branch circuit switches.*

# Needless Motor Shutdowns Decreased Where We Installed BUSS Super-Lag Renewable Fuses"

## *Says* Mr. Frank M. Herrick, Chief Engineer, Minnesota Valley Canning Company, Le Sueur, Minnesota

*"Our canning operations are tough on fuses," continues Mr. Herrick, "because our operating season is so limited we operate 22 hours a day—and use the other two hours to clean up the machines. The plants are thoroughly washed, consequently, the steam and moisture tightens motor belt drives. Condensation and moisture in the motors, plus tightened belts, make motor starting conditions a heavy burden on fuses. BUSS Super-Lag fuses have definitely minimized this problem because of the long time-lag and positive contacts of the fuses.*

*"Where we have installed BUSS Super-Lag Fuses we have noticed an appreciable decrease in needless shutdowns, which we credit to the time-lag of BUSS Fuses as well as to their simple design."*



*Some of the equipment on which there are some 365 electric motors from ⅛ to 15 horsepower.*

# BUSS Super-Lag

Do you have a tough fuse problem—like the one at Minnesota Valley Canning Company? You can probably solve it as easily as Mr. Herrick did—by using all BUSS Super-Lag fuses.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

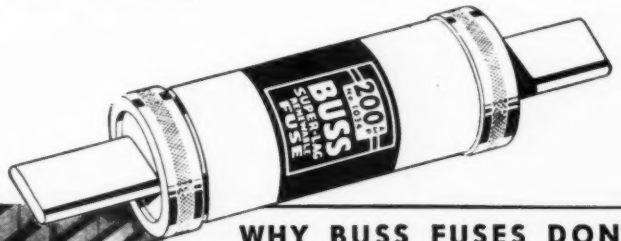
**Here is why BUSS fuses greatly reduce or entirely prevent needless blows**

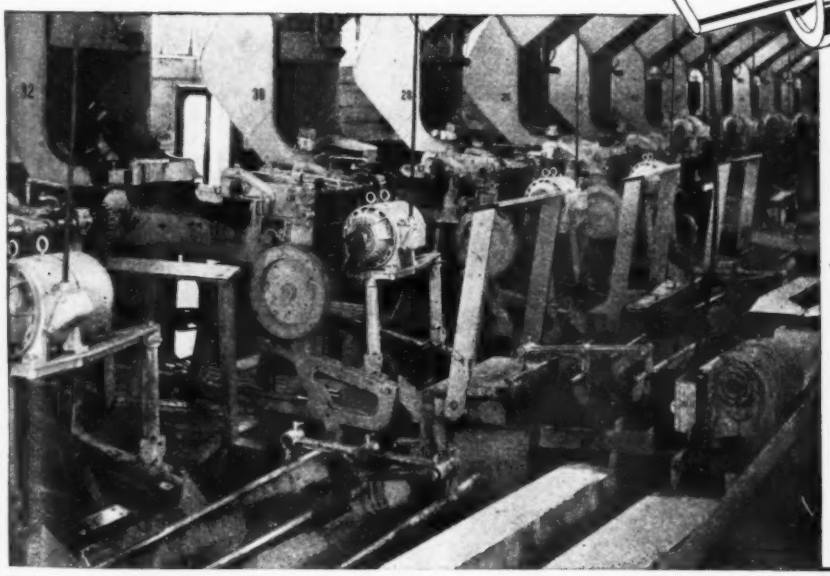
The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heating which causes fuses to blow needlessly is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

**How to solve the "shutdown problem"**

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford. BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo., *Division McGraw Electric Company.*



**WHY BUSS FUSES DON'T BLOW NEEDLESSLY**

**TEN FEATURES**

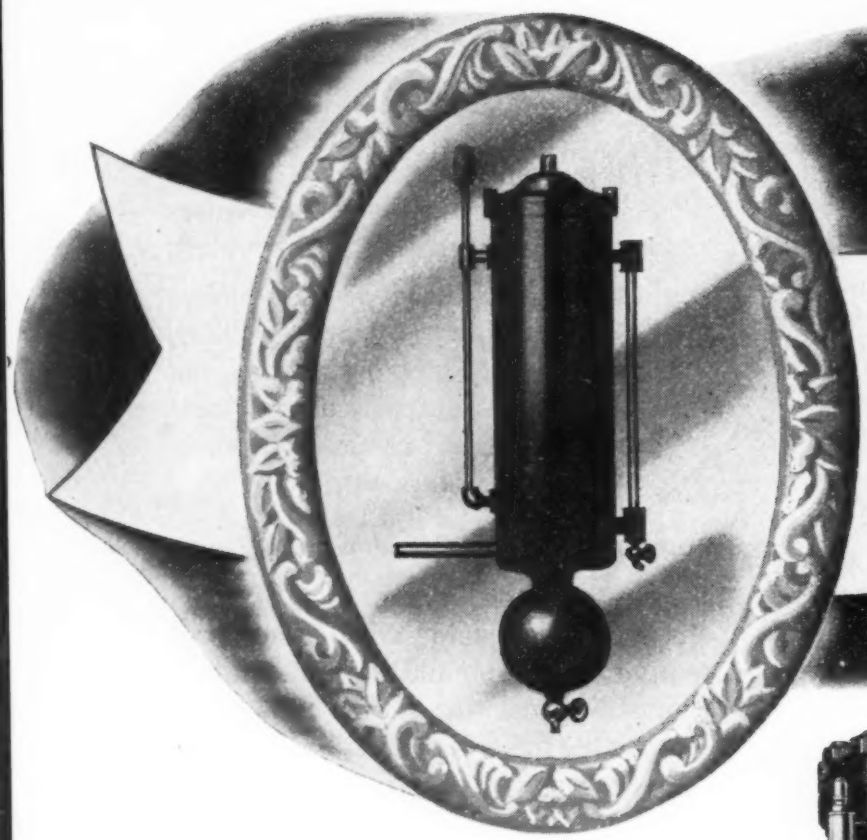
**in the design of the FUSE-CASE help make it possible.**

***and* THE SUPER-LAG**

**development in the FUSE-LINK completes the job.**

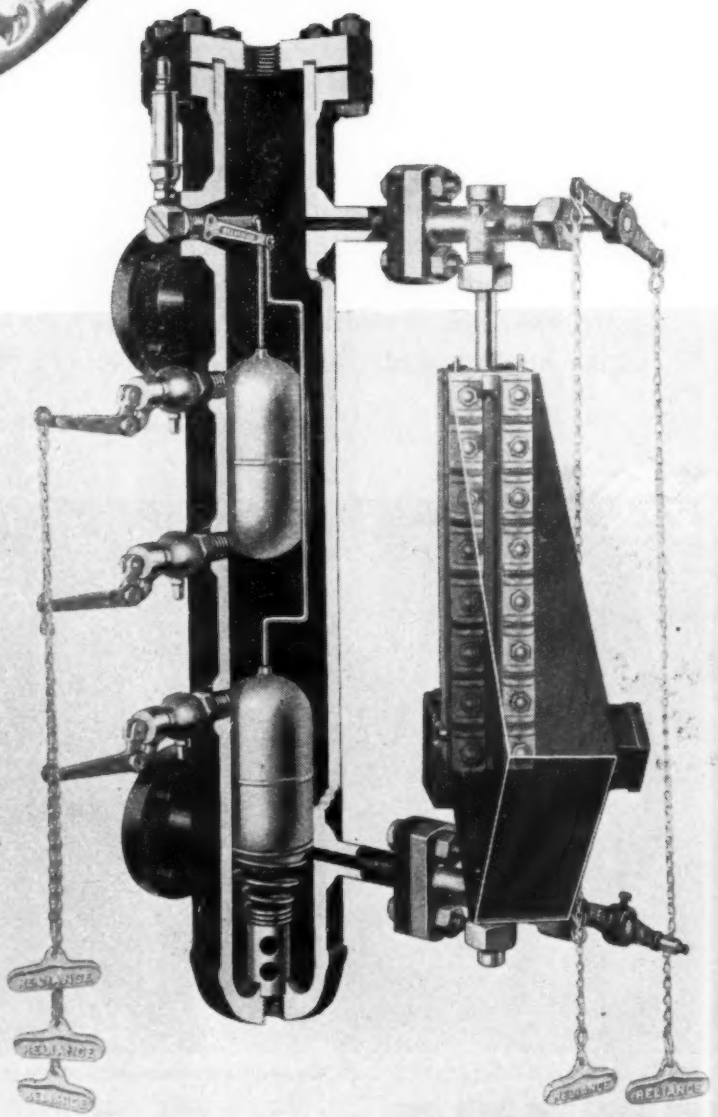
*The Minnesota Valley Canning Co. plants turned out nearly a million cases of these fine products in 1943.*

# FUSES SOLD THROUGH WHOLESALERS



It's sa

Reliance



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BUY MORE WAR BONDS

# 't safe gamble your grandfather had a ater Column on his power plant boiler

## . . . 60 years exclusive manufacture of Boiler Safety Devices—with constant development of important improvements

Nineteen Forty-four is the 60th Anniversary of the Reliance ALARM Safety Water Column and the Company that makes it. By conservative estimate, the 150,000 Reliance Water Columns that have been placed in service since the original design was marketed may have operated approximately 15 *billion* service hours, making liberal allowance for out-of-service time, replacements with newer equipment, etc. • This famous boiler safety device has improved with boiler needs, step by step as pressures and temperatures have risen. Today it stands unmatched in performance and dependability—selected as standard equipment by many of the principal boiler manufacturers and consulting engineers. • Reliance ALARM Water Columns, Water Columns without alarms, the remote reading EYE-HYE Water Level Indicator, and the comprehensive line of Reliance Gage Valves, Cocks and Gage Inserts have earned and filled an outstanding place in stationary and marine power plants—in peace time and in war—have firmly established Reliance leadership.

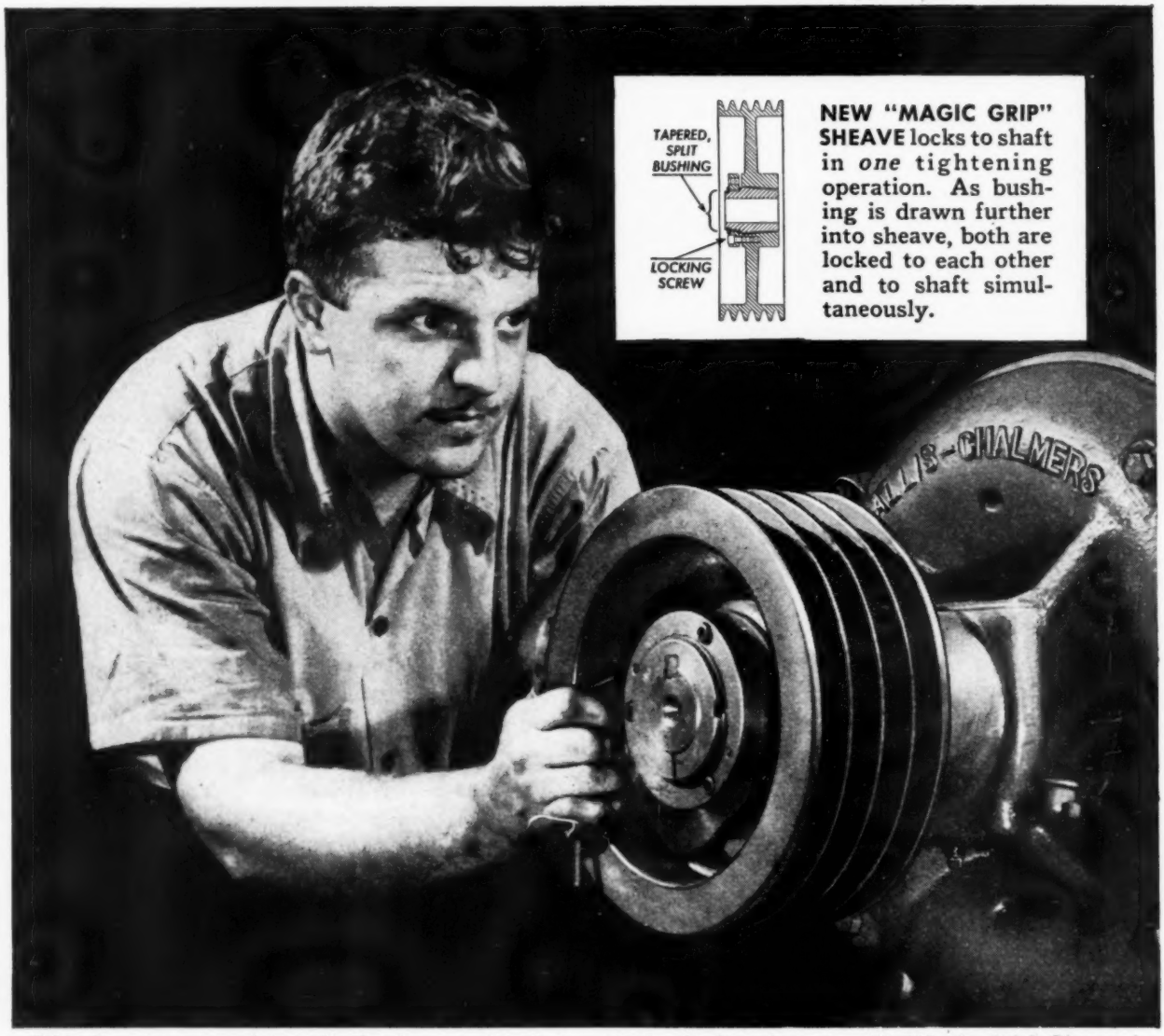
**THE RELIANCE GAUGE COLUMN CO. • CLEVELAND 3, OHIO**

1884-1944

# Reliance

## BOILER SAFETY DEVICES

# PRODUCT OF THE MONTH


TAPERED, SPLIT BUSHING
LOCKING SCREW
NEW "MAGIC GRIP" SHEAVE locks to shaft in *one* tightening operation. As bushing is drawn further into sheave, both are locked to each other and to shaft simultaneously.
ALLIS-CHALMERS

*Slide it on as a complete unit, line it up, and lock it — that's all there is to it with "Magic Grip" Sheaves!*

**MILWAUKEE, WIS.—Allis-Chalmers announces the new "Magic Grip" Sheave . . . designed to save man-hours and money by going on or off faster than any other sheave on the market. New "Magic Grip" Sheave fits undersize or oversize shafts, centers perfectly, runs smoothly. Send for Bulletin B-6310.**

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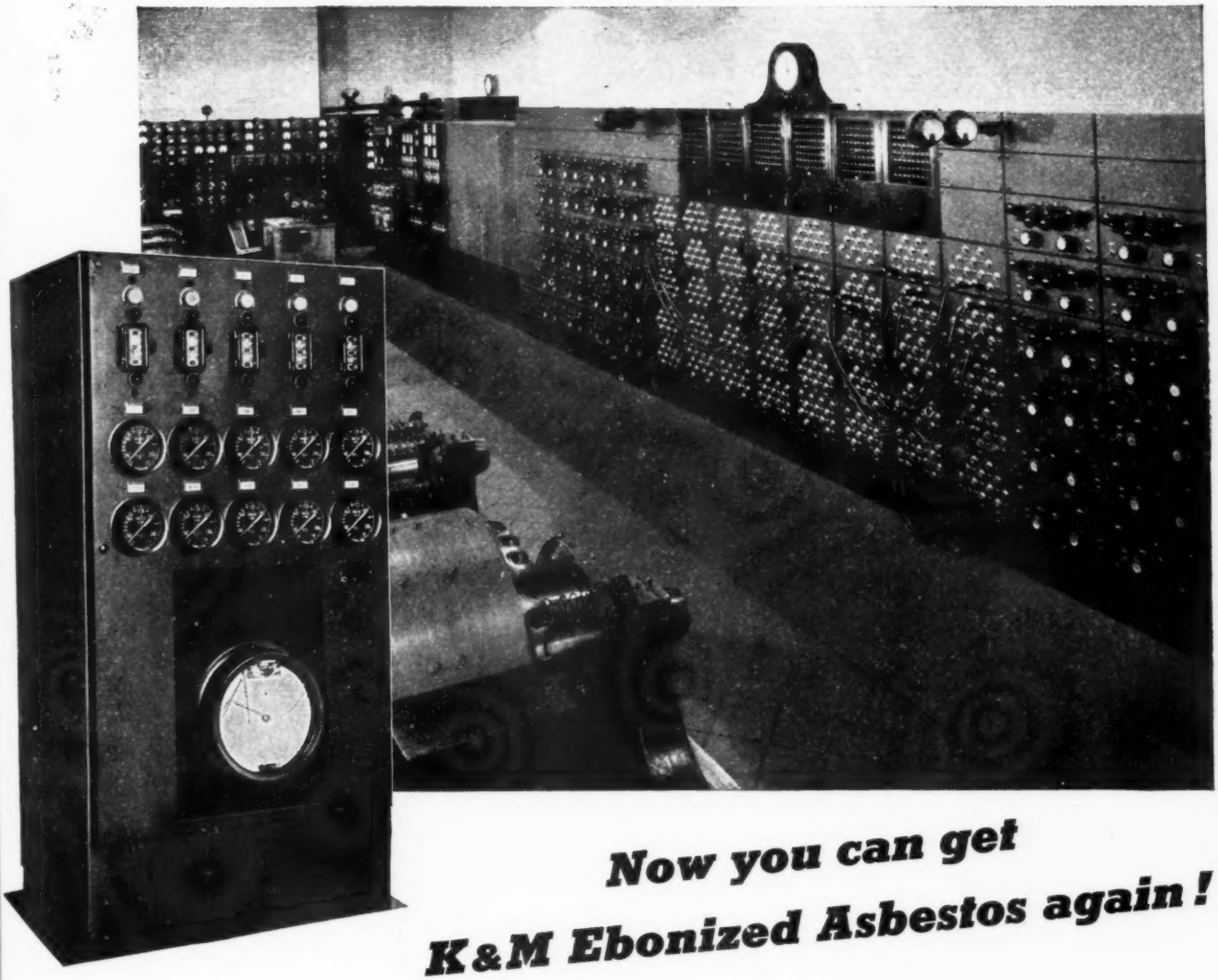
WE WORK FOR VICTORY · WE PLAN FOR PEACE

**ALLIS-CHALMERS · MILWAUKEE · WISCONSIN**



# Now you can get K&M Ebonized Asbestos again!

Substitutes are no longer necessary . . . the *ideal* mounting for electrical installations is available again—K&M Ebonized Asbestos!

This is the *preferred* material for switchboards, bus bar runs, testing tables, panel boards and similar uses . . . preferred for the unusual sturdiness of its pressure-molded sheet construction . . . for its exceptional dielectric strength . . . for its ability to withstand severe shock, vibration and rapid temperature changes . . . and for its resistance to the effects of oil and moisture.

The demands of our armed forces and of many essential war industries have, heretofore, taken our entire output of K&M Ebonized Asbestos, even though production was considerably increased.

Now, having met many of these needs, we can supply you with K&M Ebonized Asbestos in thicknesses of ⅛-inch to 4 inches, with "standard" or special "panel" finish.

K&M Ebonized Asbestos meets the technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

* * *

*Nature made asbestos;*
*Keasbey & Mattison, America's asbestos pioneer, has made it serve mankind . . . since 1873*

**KEASBEY & MATTISON**
**COMPANY, AMBLER, PENNSYLVANIA**

★ Our Ambler plants proudly fly the Army-Navy "E" flag—an honor awarded K&M employees "for outstanding production of war materials."

# *Why an* **MP** *in a*

Well—you know what "Military Police" signifies, don't you? It's the designation of specially qualified, specially fitted men who are charged with the duty of seeing that "things run smoothly." One of their most important functions, wherever troops and supplies are located, is to *control the flow* of traffic.

So—that "M P" is in this advertisement because he signifies the thorough-going job performed by POWELL VALVES in every branch of industry—in *controlling the flow* of liquids and gases—often under the most exacting conditions.

**The Wm. Powell Co.**
***Dependable Valves Since 1846***
**Cincinnati 22, Ohio**

**Fig. 500**—125-pound Bronze Gate Valve with screwed ends and screwed-in bonnet. Sizes ¼" to ¾" equipped with taper wedge solid disc; sizes 1" to 3" with taper wedge double disc.

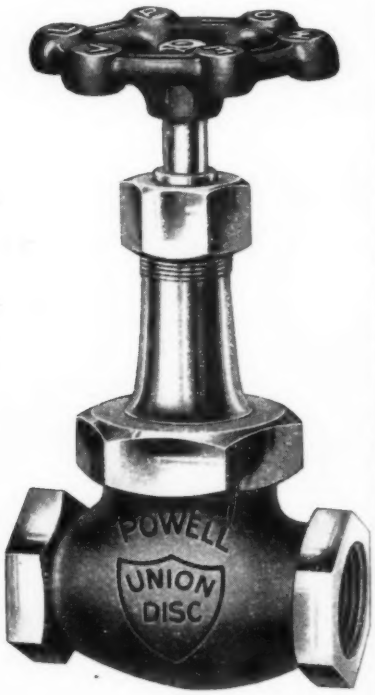



**Fig. 150**—Bronze "Union Disc" Globe Valve for 150 pounds W.P. Screwed ends, union bonnet, and renewable vulcanized composition disc—especially adapted for throttling service—for the control of low-pressure steam, oil, water, gas, etc.

**POWELL**

# POWELL VALVE ad?

The complete POWELL Line includes Globe, Angle, Gate, Check, Relief, Y, Non-Return and other types of valves in bronze, iron, steel, pure metals and special alloys to meet the demands of all branches of Industry for DEPENDABLE FLOW CONTROL EQUIPMENT.

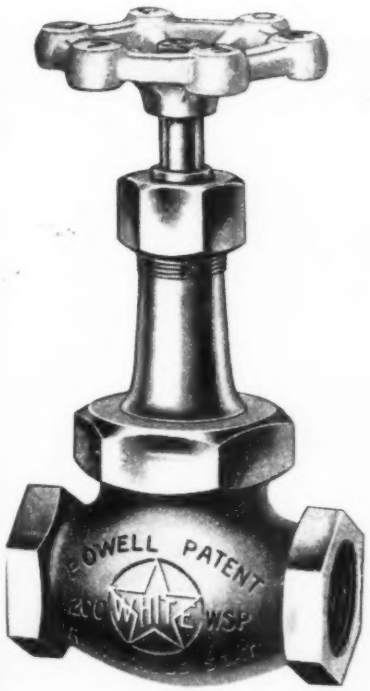



**Fig. 1708**—Bronze Globe Valve for 200 pounds W. P. Has screwed ends, union bonnet, renewable seat and regrindable, renewable hard bronze semi-cone plug type disc — especially adapted for throttling service—for the control of low-pressure steam, oil, water, gas, etc.

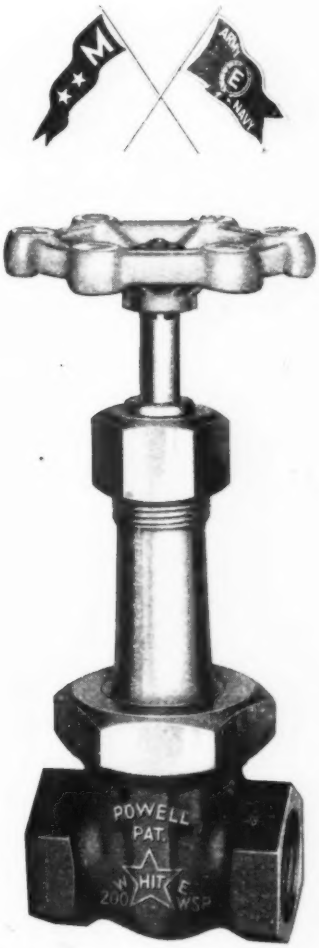
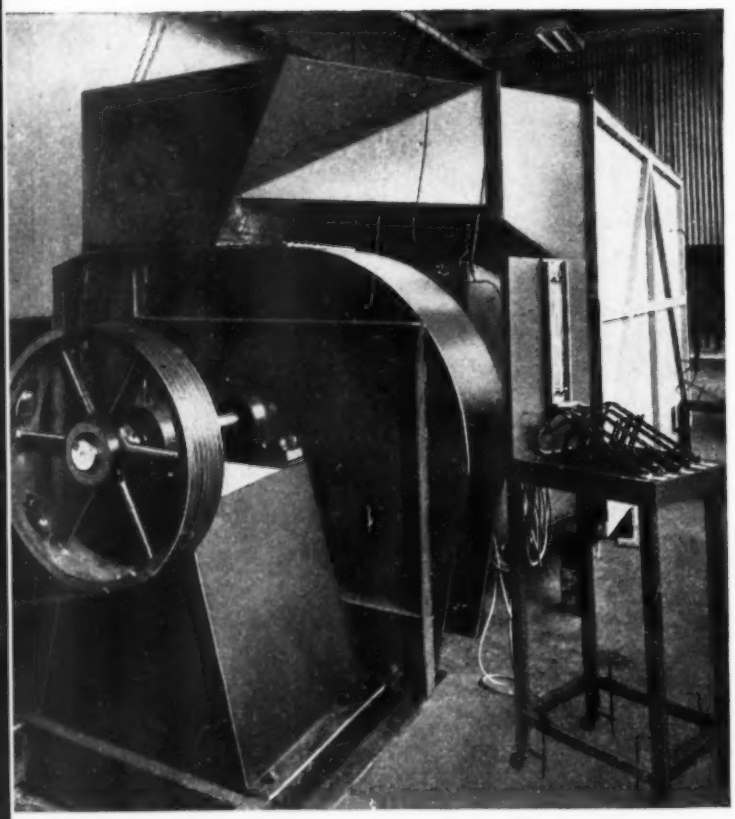



**Fig. 375**—Bronze Gate Valve for 200 pounds W. P. Has screwed ends, union bonnet, inside screw rising stem and a special hard bronze disc.

# VALVES

# *Progress and Power* in the



**A test conducted** in the American Blower research laboratory to determine the air flow and resistance of a dehydrogenation catalyst case.

Tremendous progress has been made in th rubber industry. New developments . . . ne processes . . . new synthetics . . . entirely ne plants.

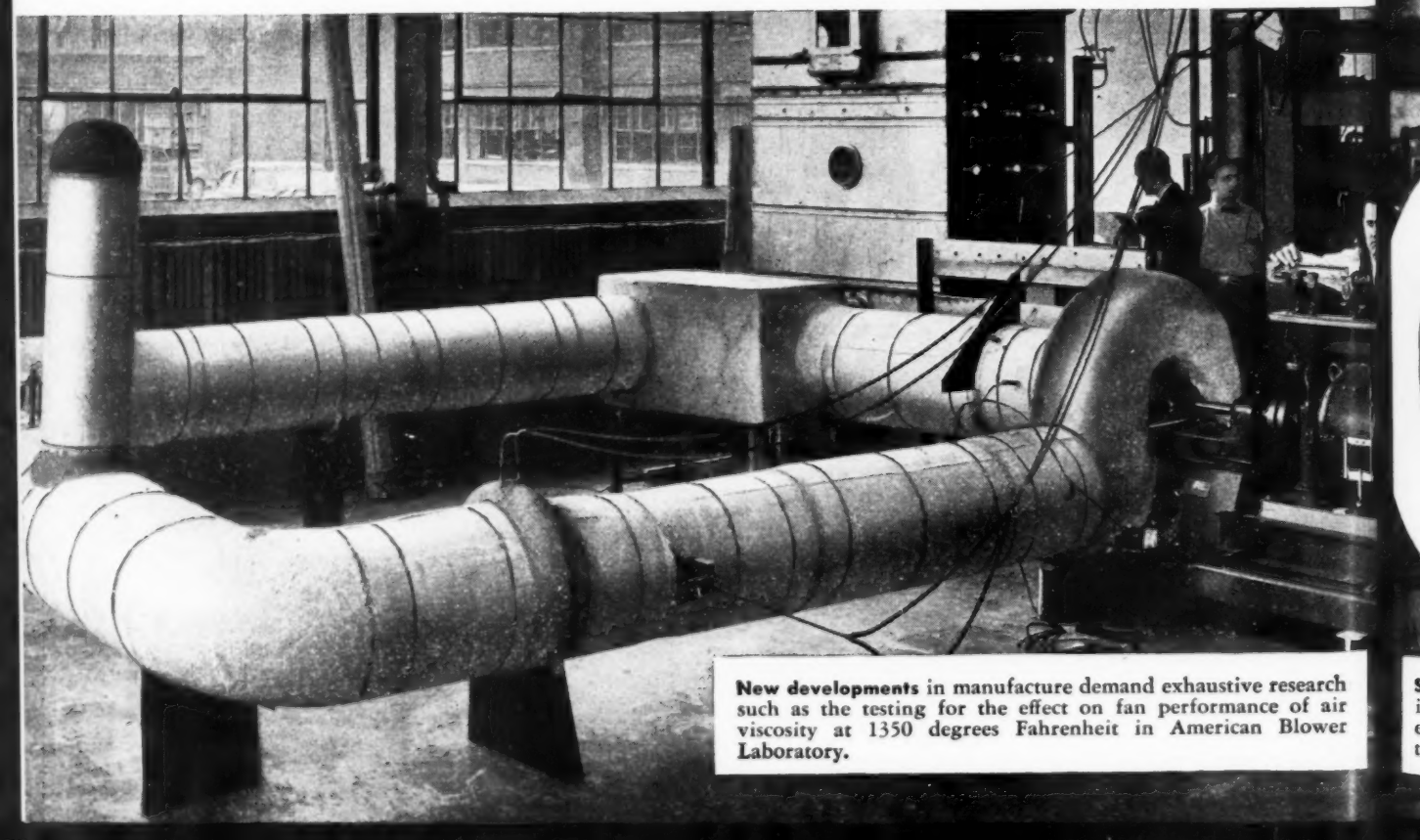
Behind this seemingly impossible task lie a story of co-operation — close co-operatio on the part of machinery manufacturers an co-operation on the part of America's grea Public Utilities in furnishing the added powe to produce the goods.

American Blower co-operated by conduct ing exhaustive research studies and develop ing special air handling and conditionin equipment to withstand the grueling condi tions of a greatly expanded rubber industry Our knowledge gained through the years, building standard as well as specialized air handling equipment for industry, is available to you.

AMERICAN BLOWER

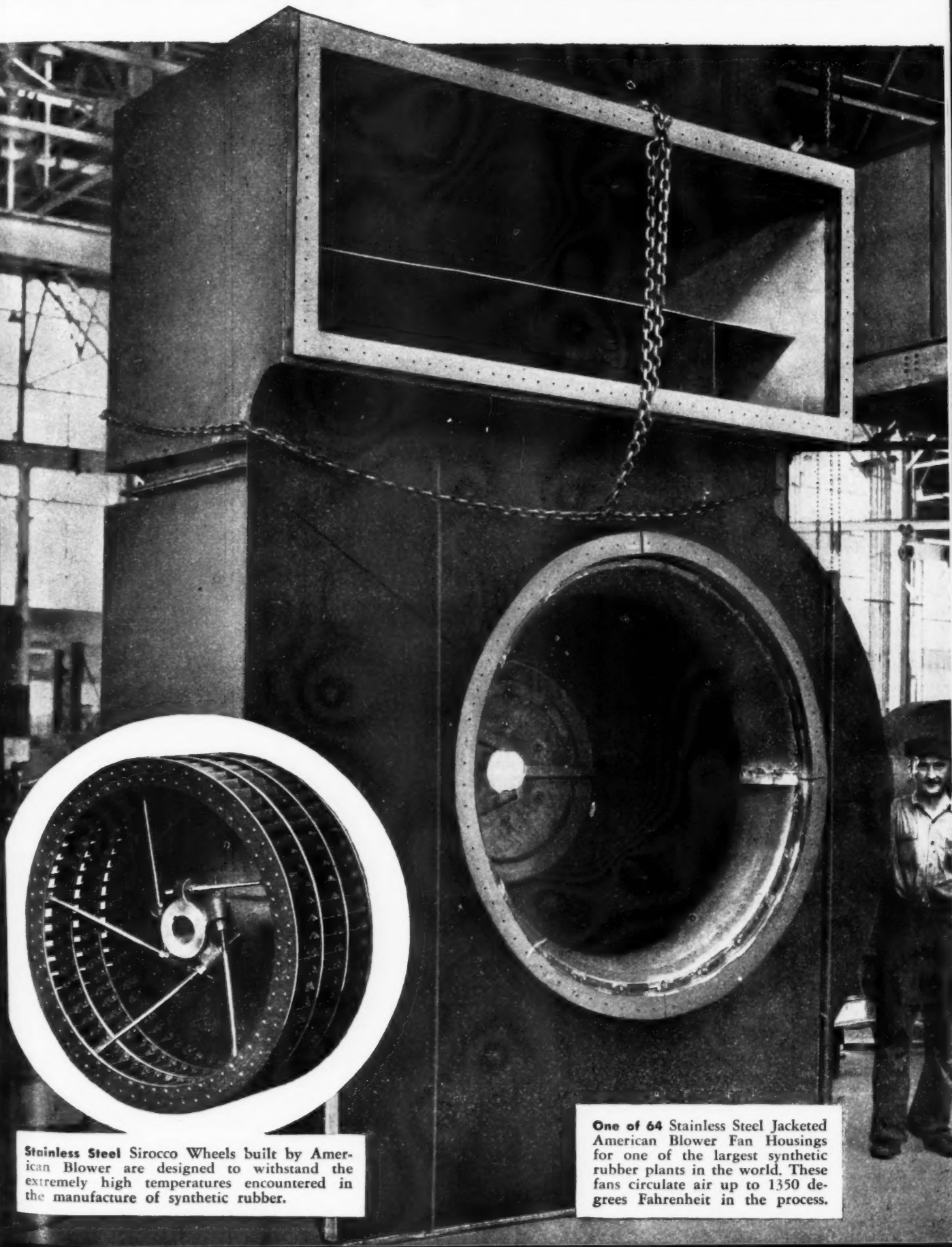
ARMY E NAVY
For Production
"Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MIC
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ON
Division of AMERICAN Radiator & Standard Sanitary Corporat



**New developments** in manufacture demand exhaustive research such as the testing for the effect on fan performance of air viscosity at 1350 degrees Fahrenheit in American Blower Laboratory.

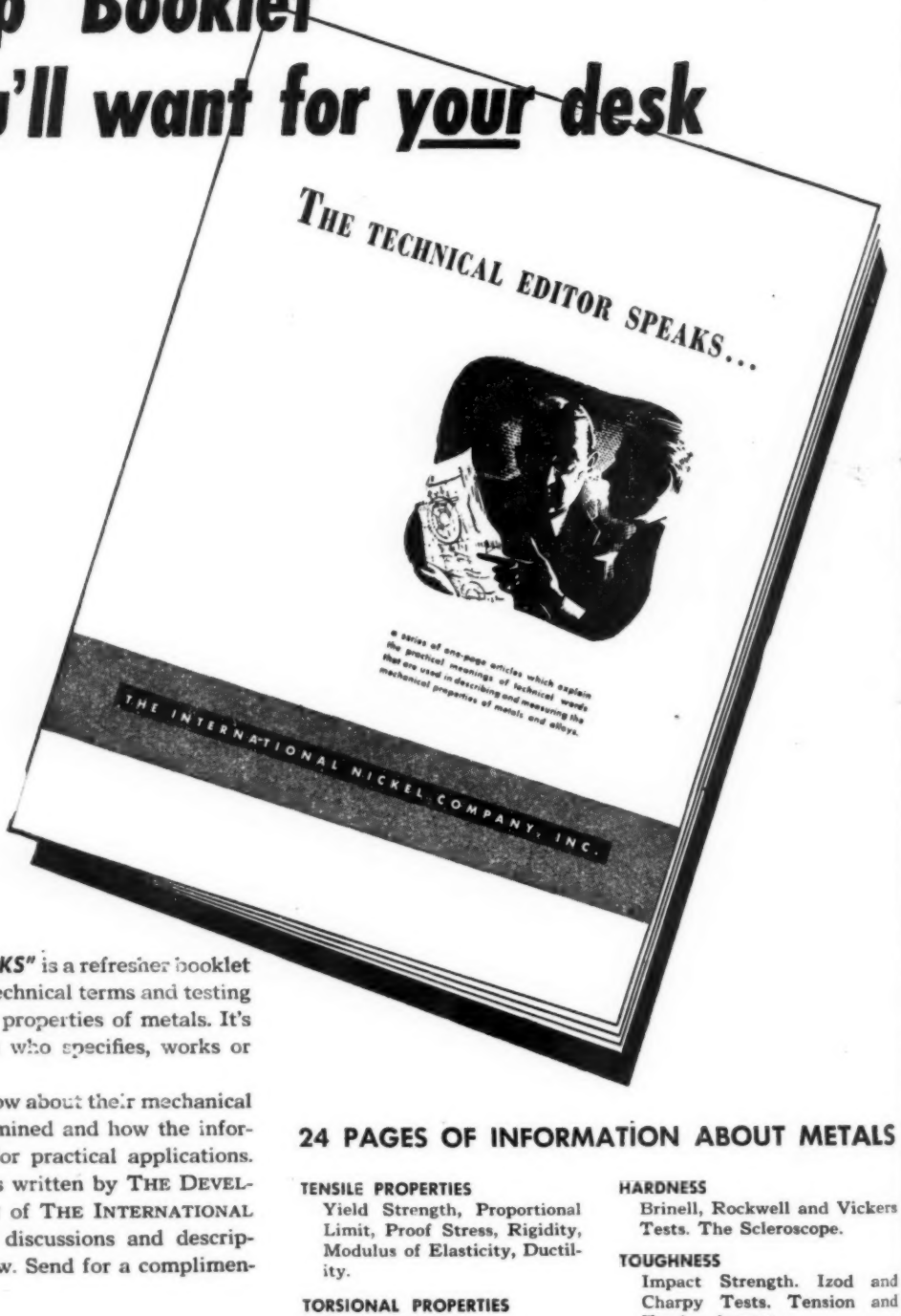
# RUBBER INDUSTRY



**Stainless Steel** Sirocco Wheels built by American Blower are designed to withstand the extremely high temperatures encountered in the manufacture of synthetic rubber.

**One of 64** Stainless Steel Jacketed American Blower Fan Housings for one of the largest synthetic rubber plants in the world. These fans circulate air up to 1350 degrees Fahrenheit in the process.

# A "Brush-Up" Booklet you'll want for your desk


THE TECHNICAL EDITOR SPEAKS...
a series of one-page articles which explain the practical meanings of technical words that are used in describing and measuring the mechanical properties of metals and alloys.
THE INTERNATIONAL NICKEL COMPANY, INC.

***"THE TECHNICAL EDITOR SPEAKS"*** is a refresher booklet that brings you up-to-date on the technical terms and testing procedures used in measuring the properties of metals. It's a handy, useful guide for anyone who specifies, works or uses metals.

It tells you what you want to know about their mechanical properties . . . how they are determined and how the information is used to judge metals for practical applications. Compiled from a series of articles written by THE DEVELOPMENT and RESEARCH DIVISION of THE INTERNATIONAL NICKEL COMPANY . . . it includes discussions and descriptions of the properties listed below. Send for a complimentary copy today.

## 24 PAGES OF INFORMATION ABOUT METALS

**TENSILE PROPERTIES**
Yield Strength, Proportional Limit, Proof Stress, Rigidity, Modulus of Elasticity, Ductility.

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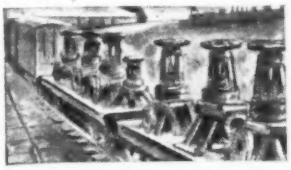
MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
*Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings*

# The 1944 Outlook on STEEL VALVES

## *A frank statement of the problems facing steel valve users*

If you have tried to buy steel valves during the past year you know that they have been among the most critical common components in American war production. Is there any relief in sight? How long will shipments take? Will repair parts be obtainable in 1944? *Here are the facts . . . .*

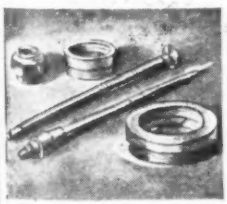


**YOU CAN HELP SPEED DELIVERIES.** Steel valve production has increased substantially in 1943, but in general has still lagged behind the extremely high demands of the war program. For at least the first part of 1944 this situation is likely to continue. There are, however, several things you can do to speed delivery of the steel valves you will need . . . .

*1. **Stick to standard valves.*** "Specials" slow down production, create order handling delays, and increase possibility that your order may not be filled since they usually require non-standard and short-run parts hard to obtain or manufacture.

*2. **See if a substitute is available.*** Often the exact type of valve you order may be oversold. In many cases a substitute valve type which will do the job as well will be available on a shorter delivery schedule.

*3. **Check your order.*** With steel valves, as with other critical war products, many delivery delays have had nothing to do with production. They have resulted from failure of the purchaser to furnish on the original order complete priority information, product description or service requirements.



**WHAT ABOUT REPAIR PARTS?** Requirements for maintenance and repair parts are naturally at a very high level as old equipment is stretched for long periods under extraordinarily heavy loads.

When a valve user orders a repair part he usually needs it in a hurry, and so we have given preferred treatment to repair part orders. Within the limitations of government regulations we will continue to emphasize prompt filling of repair part orders. Out of the great volume of part orders we filled in 1943, less than a handful were ever past due.

**WHAT'S HAPPENED TO QUALITY?** Today's Edward valves are just as good as they always have been. Recognizing that the service into which war valves go is often tougher than peace-time requirements, Edward has never relaxed material and workmanship standards. Actually there have been few changes in the materials used in Edward valves and in no case has inherent serviceability been reduced.

Nor have expanded operations and manpower losses to the armed forces altered the quality of Edward workmanship, for ours is a veteran organization with a large enough nucleus of thoroughly experienced valve builders to retain our rigid policy of every-stage inspection control with absolute power of rejections.

**WHAT'S COOKING?** Design development did not stop with the war. Edward engineering and laboratory departments have carried on an uninterrupted program of design refinement. Instead of withholding the results of this development program for a post-war splurge, each improved design—as soon as its value has been proved beyond question—was adopted as Edward standard practice in all cases where war production would not be jeopardized by such change.

Additional types of Edward valves will soon be available, probably before the end of the war. You can expect an announcement in the near future.

For as long as the war continues, the Edward plant will devote its facilities to the kind of on-schedule production that has won the Victory Fleet Flag, the Maritime "M" pennant, and an additional Gold Star, without prejudice to the service and planning needs of purely peace-time customers. And when V-day comes, the Edward plant will be ready.

W. F. Crawford
*President*

**The Edward Valve & Mfg. Co., Inc.**

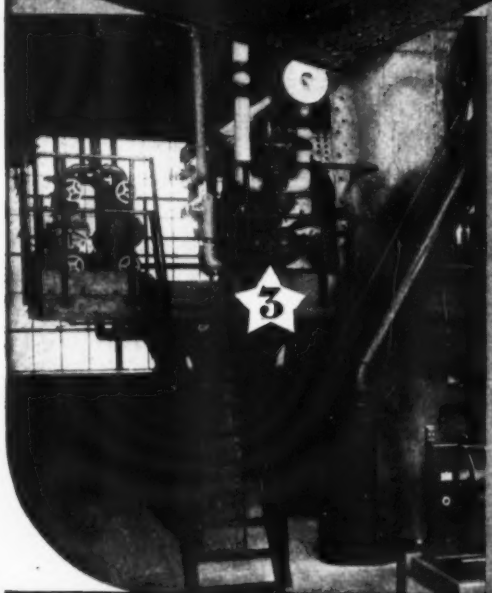
***Building a complete line of steel valves for all land and marine service temperature and pressure conditions.***

EAST CHICAGO INDIANA

# To Avoid Fire Hazard

## ISOLATE OIL FROM HIGH-TEMPERATURE STEAM

De Laval turbine driving 4000 kw. alternator (5000 kw. maximum)




IN this De Laval multistage turbine power is transmitted mechanically to the valve-lifting gear 1 at the top of the casing from a pilot-controlled hydraulic cylinder in the sub-base, 2 which also encloses the speed governor, accumulator and relief valve, and other parts relating to the governor control.

The main reservoir for both lubricating and hydraulic pressure oil, the main and auxiliary oil pumps, the strainers, and the oil coolers are located on a platform 3 below the sub-base.

No oil cylinders or oil piping are over the steam chest or the steam piping, thus keeping oil away from high-temperature steam.

Other requirements of high-pressure, high-temperature steam have been met by the use of special alloys and improved design throughout.

*Ask for Publication T-3527*

# DE LAVAL Steam Turbine Co.

TRENTON, N. J.

MANUFACTURERS OF TURBINES · STEAM · HYDRAULIC · PUMPS · CENTRIFUGAL · PROPELLER · ROTARY · DISPLACEMENT · MOTOR-MOUNTED · MIXED-FLOW · CLOGLESS · SELF-PRIMING · CENTRIFUGAL BLOWERS and COMPRESSORS · GEARS · WORM · HELICAL and FLEXIBLE COUPLINGS

# POWER

JANUARY 1944

VOLUME 88
NUMBER 1



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*Engineering*

# A TURBINE TO UTILIZE A MILLION POUNDS OF STEAM PER HOUR

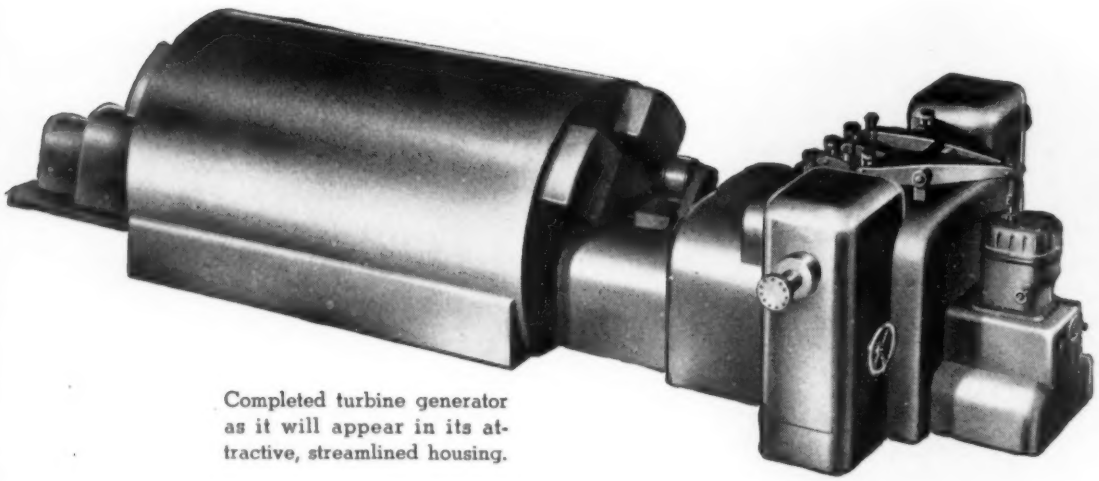
It takes a lot of steam to make a pound of synthetic rubber—approximately 40 pounds. In a 100,000 ton-per-year Buna S plant, for example, a million pounds of steam per hour can be harnessed. And recently, Westinghouse engineered such a job.

Westinghouse steam engineers designed a 35,000 kw noncondensing turbine generator—with immense twin throttle valves.

Steam was supplied at 700 pounds, 750°—exhausted at 165 pounds. The entire unit, huge because of unusually low steam pressure, was enclosed in an attractive, streamlined housing.

This turbine application, involving many special requirements, was designed quickly and efficiently by Westinghouse. Similarly, your steam problems, now or postwar, can be solved by Westinghouse engineering. Call Westinghouse for details.

J-50444

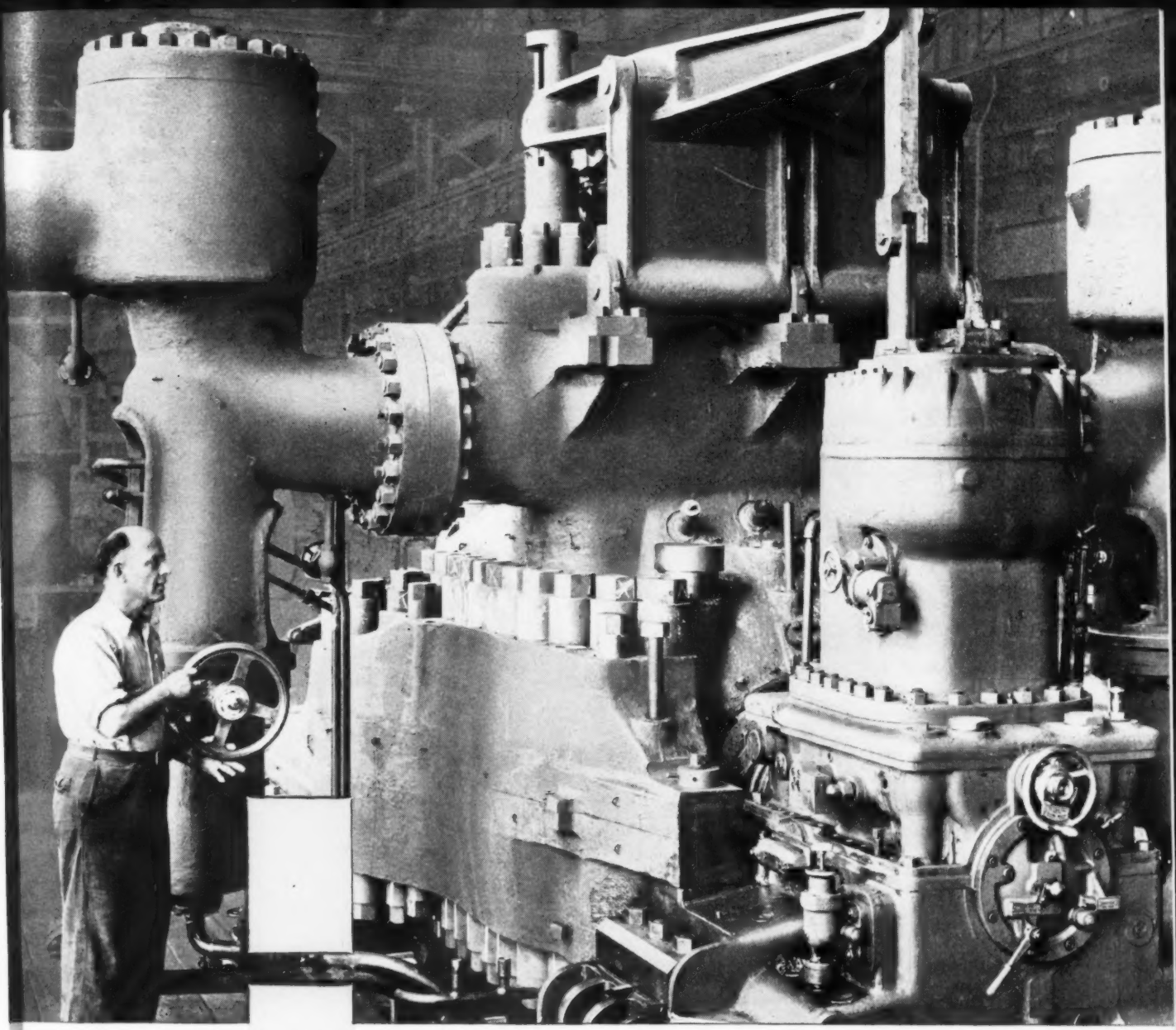


Completed turbine generator as it will appear in its attractive, streamlined housing.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

*Steam Headquarters*



## HOW CRITICAL ALLOYS WERE SAVED

Alloys are scarce—carbon steels more plentiful. So this huge turbine was designed for conservative steam conditions. Low steam pressures required huge steam areas. These conditions, however, resulted in important alloy savings throughout the plant. By keeping steam temperatures within the working limits of carbon steel, turbine parts, super-heaters, valves and piping could be made from this more plentiful metal.

Westinghouse

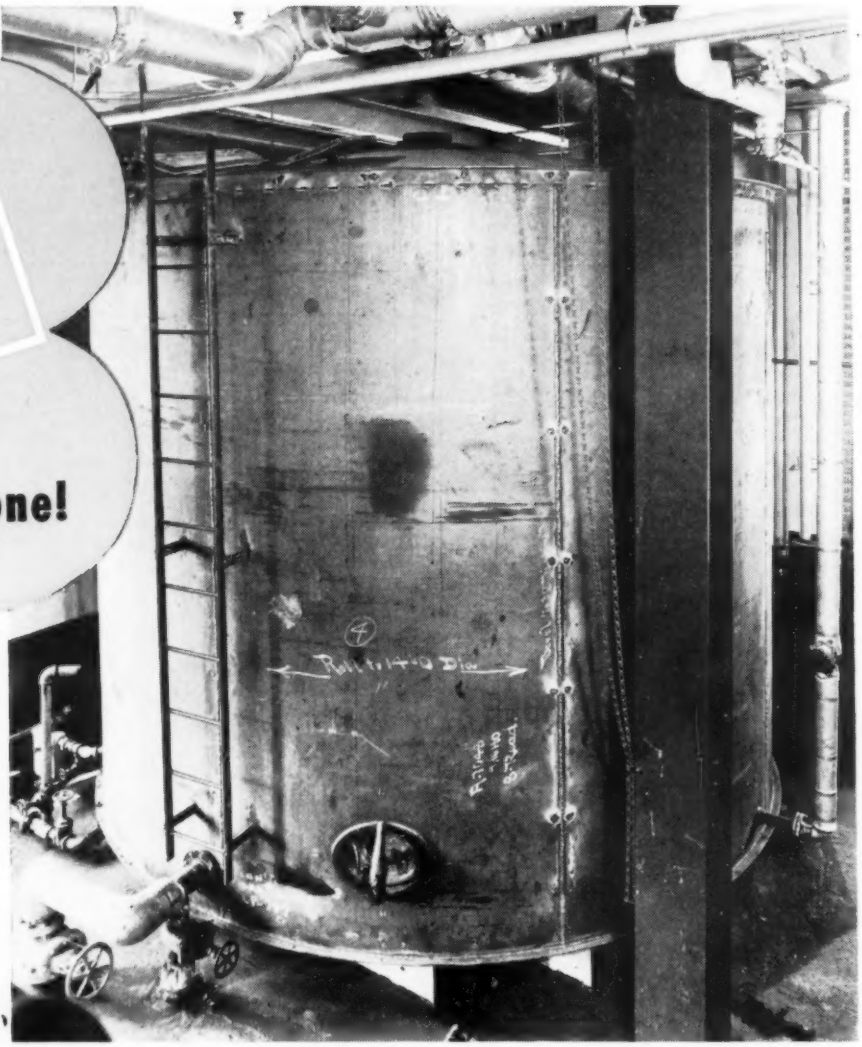
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

*Steam Headquarters*

WESTINGHOUSE

# BYERS WROUGHT IRON

## The records of 3 old tanks wrote the "Specs" on this new one!



Hot water storage and supply is a problem that's encountered in every structure . . . which makes this story of particular interest to every engineer.

Back in 1937 the Duquesne Brewing Company of Pittsburgh, Pa., installed a hot water tank made of low first cost material. This tank failed after only 6 years. The possibility of much longer useful life from wrought iron was suggested by the fact that two wrought iron tanks, also built in 1937 for severe corrosive service, were still on the job. After investigation, the engineers built the new hot water tank of Byers Wrought Iron. The company is also installing wrought iron for all piping in new construction and for maintenance, and has used several thousand pounds in hoops for wooden tanks.

Water varies so widely in its corrosive characteristics that the only safe guide in specification is actual experience under field conditions. Even though you may not have personal knowledge of the performance of wrought iron in any specific application, you can still make your selection on this basis, for our Engineering Service Department will give you service records received from other engineers.

The excellent results obtained from wrought iron in corrosive services stem directly from its two-component structure. Tiny fibers of glass-like silica slag are threaded through the high-purity iron matrix. Corrosive attack is continuously retarded and diffused. In addition, the initial protective film is firmly anchored in place, which helps to shield the underlying metal.

You will find some interesting and helpful information in our bulletin, "Wrought Iron for Tank Construction." May we send you a copy?

A. M. Byers Company. Established 1864. Offices in Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

**BYERS**

**GENUINE WROUGHT IRON**

**TUBULAR AND HOT ROLLED PRODUCTS**

ELECTRIC FURNACE ALLOY STEELS • OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

***SCRAP needed! Iron ore shortage may cut steel production unless MORE scrap fills the gap. Current collections aren't enough. It is everybody's business. Please help.***

# Reconversion *and* Contract Termination

AMERICAN industry is dedicated to an all-out effort to achieve victory, and its good faith in this direction is amply demonstrated by the results.

American industry also is dedicated to making democracy work effectively after the victory. And it is toward this objective that industry must prepare itself to guide the processes of demobilization and reconversion in order to minimize the dislocations and chaos which too easily can result from so tremendous a task.

We exercised foresight from the very beginning of the war mobilization program. Let us now exercise foresight in the approaching changeover from a wartime to a peacetime economy.

The first step in converting American industry from military to civilian production is the termination of contracts between the government procurement agencies and the producers. There are now in force war contracts amounting to tens upon tens of billions of dollars. As the demand for weapons of war decreases, the Armed Services will undertake to cancel contracts. With the emphasis shifting from weapons of one category to weapons of another category, many billion dollars worth of contracts already have been terminated. It is hoped that the experience now being gained in this work will provide the basis for effective and sound procedures when an avalanche of cancellations comes later.

Many complex problems involved in the termination of contracts will materially influence the success of the entire reconversion program. Once war demands fall off sufficiently to permit the renewal of civilian production, we will have to act with great speed if we are to avoid large-scale unemployment. Prompt financial settlements of contracts and the rapid clearance of plants are of immediate and great significance. In many cases the removal of equipment and raw materials will be more important than money payments. The allocation of raw material for civilian production will be of paramount importance.

Government agencies obviously must exercise great care in spending the people's money and in protecting the interest of the public against excessive payments. Unjust enrichment at the expense of the people will not be condoned nor will it reflect favorably upon management to present inflated claims. But long-delayed negotiations, which will retard the initiation of civilian production, likewise must be avoided.

The contracting agencies and the manufacturers both know that the greatest losses in the reconversion period will result from delays in getting peacetime production under way. The

greatest potential wastes lie in unemployment and in idle plants. The magnitude of such losses to the public can be far greater than the money spent in liberal settlements; to the manufacturer, these losses can represent vastly more than the extra funds that might result from interminable litigation. Policies must be firmly established ***now*** whereby the manufacturers, including subcontractors and suppliers, will receive substantial settlements immediately in order that ample funds be available for reconverting plants and accumulating necessary inventories of peacetime goods. Nor must we overlook the fact that the uncertainty of long drawn-out disputes will have a stifling effect on enterprise and that final settlements, therefore, should be made as promptly as possible.

Plants that are equipped largely with special wartime tools and machines and that are fully stocked with materials, components, and finished military products will not be able to undertake any substantial degree of conversion until this machinery and this inventory are removed. Advance arrangements are essential for the prompt clearance of great numbers of plants the country over. Adequate warehousing facilities must readily be available so that the changeover to civilian production will not be hampered.

As war demands decline, civilian output will be resumed; and while we recognize that the demands for munitions must vary as the strategy of the military leaders is changed, it is hoped that the Armed Services already have or soon will develop schedules of their continued needs under different strategic assumptions. If we know in advance the probable curtailment in war requirements we are in position to estimate the timing and the quantities of raw materials, the number of workers, and the industrial facilities which will be available for peacetime purposes. It will then be possible to integrate the lifting of restrictions on civilian production with the drop in war production.

Needless unemployment and idle plants will prevail if restrictions on the output of civilian goods are removed at a slower rate than available manpower, materials and plants permit. On the other hand, if the controls on civilian production are removed prematurely or too freely, then the production of military requirements will be hampered correspondingly. There will be great clamor and pressure for eliminating all restrictions as soon as any measurable quantity of materials and numbers of workers are freed from war work. It will react adversely on industry as well as on government if these pressures are heeded indiscriminately, thereby retarding the production of munitions for our boys who still will be fighting and dying at the front. The coordination of declining war demands with increasing civilian production probably is the most difficult and at the same time the most important task in our entire reconversion problem. Advance planning and sound judgment are essential.

An order of priority for initiating non-war or civilian production must be prepared beforehand. The schedule of resumption of peacetime production should be governed by the amounts of

materials, manpower and facilities that are available as well as by the relative needs or importance of different products. There will be strong competition for priority among the various kinds of consumer goods, equipment needed for reconversion, producers goods required for expansion and modernization, and export demands. Relative need obviously is the most compelling criterion. But because of the importance of expediting reconversion, earliest consideration is urged for the tools and fixtures and models which will expedite large-scale civilian production when adequate labor and materials are available. In any case, advance schedules will be needed to avoid a makeshift, piecemeal lifting of controls on the basis of who shouts the loudest.

Another difficult problem of the reconversion period will be to keep to a minimum the distortion of inter-industrial and intra-industrial relationships. Many varieties of consumers goods compete for the consumer dollar, and some industries will offer strong resistance if the green light is given first to industries whose products may thereby acquire a time advantage.

Even more difficult will be the matter of competition between companies producing the same products. Some manufacturers may find themselves tied up with continuing war contracts with restrictions on their peacetime products suddenly lifted and their competitors free to take advantage of the situation. The declining need for different kinds of war materiel will vary greatly, and some producers inevitably will be available for peacetime production considerably in advance of some of their competitors.

This raises the question of victory models or nucleus plants to eliminate competitive advantages among producers of identical products pending the time when all are on an equal footing again. Policies controlling this should take into account the degree or the extent of competitive advantage which reconversion might bring, and also upon the time interval during which these advantages will prevail. Such programs necessarily mean increased government control, hence they should be adopted only under the most pressing circumstances.

There is the important question of termination as between large and small plants. Fairness must be exercised, and undue advantage to either group must be avoided in extending opportunities to continue receiving profitable war orders or in getting back into civilian production. The problems of small manufacturers must not be neglected in this period. Likewise, any restraints on new ventures and on more vigorous competition must meticulously be avoided.

There also is the question of communities which have been greatly enlarged and others which actually have been brought into being by the war. It might be advisable to terminate contracts in these areas first in order that the workers might be encouraged to migrate elsewhere while employment prospects are most favorable. Also, if continued production of some armaments is contemplated after the war, it might be well to concentrate this production in communities which otherwise would be stranded.

If the process of terminating contracts is to be geared into meeting continued demands for munitions and also expediting reconversion, then the Armed Services must accept broad policy considerations as criteria for cancelling contracts. Procurement officers might be inclined to cancel contracts with all high cost producers first. Or they might be inclined to cancel small producers first so as to reduce the administrative burden. Then again, they might cancel the newer producers of specific products rather than the older, time-tried manufacturers.

These procurement criteria may all be highly desirable and efficient but other important considerations such as those mentioned above must be given proper attention. ***Demobilization cannot be a separate process from reconversion.*** They must be united. The termination of contracts is a demobilization task, but I am confident that the procurement agencies appreciate the importance of this operation in facilitating reconversion and that they will take full cognizance of the policies necessary for giving every assistance to initiating peacetime production.

I have not attempted to raise all the important policy questions in terminating contracts, nor do I propose specific solutions for each major problem. Rather it has been my purpose to indicate the complexities of the task which faces us and to urge that intelligent and sound plans be developed now while there is time. By so doing, we can avoid the dislocations and economic disorder which otherwise might characterize the reconversion period. The better we are prepared, the more rapid will be the resumption of full employment and good business after the war is won.

This job of changing America's industrial pattern from war to peace speedily and efficiently, is one which will tax the talents and knowledge of the ablest business men of the country. These men can, and I am sure that they will, attack this task with the same energy and determination that characterized their efforts in the period of mobilization for war.

Industry advisory committees were established to cooperate with governmental agencies in the great task of conversion to a full war economy. These committees are the means through which industry has the opportunity to play a major role in the solution of the problems of reconversion. It must assume that responsibility or accept the consequences in the form of enforced government control. Industry must take a renewed interest in these committees and make certain that our best minds and strongest men are available for the challenging job of conversion which we face now. It is a job that must be done well if we are to have a good start on the road to a greater democratic and free enterprise nation.

*President, McGraw-Hill Publishing Company, Inc.*

PHILIP W SWAIN, EDITOR

POWER

ESTABLISHED IN 1882

# *Pre-Peace Problems Demand Solution*

RIGHT NOW pre-peace and post-war problems are sitting on our doorstep, crying for attention. War or no war, we must do something about them or fumble the peace.

All the pains and troubles will center around industry, where the power man lives, so he must share the dangers and the defense. Below, in outline, are the major problems, with practical suggestions from well informed sources—starting points for constructive discussion and action:

## MANPOWER AND JOBS

The employment situation is confused. Manpower shortage grows more acute nationally while production cut-backs lay off workers here and there. Meanwhile 100,000 soldiers and sailors (disabled, etc.) drift back into "civies" every month. Imagine twenty to thirty million people changing jobs at the end of the war. What then?

Neither government nor industry has really faced this problem. It's time to start.

## CONTRACT TERMINATION

When Germany falls, war contracts will be cut 50 to 80% almost overnight. Here are suggestions to ease the shock: Let Congress appoint a body (not Army or Navy) to set up commonsense policies for quick settlement and payment of amounts due contractors. This matter is crucial; don't let bureaucratic dawdling, red tape and legal hair-splitting strangle the reconversion of industry to peacetime production. And remember that many small companies must get their cash quick or quit.

## GOVERNMENT PLANTS

Government-owned war plants costing billions must not be left as a standing threat to private initiative. Let government decide now which plants to hold as war insurance and which to sell or lease for private operation—for what they are worth, not what they cost originally.

## OTHER GOVERNMENT PROPERTY

Wholesale contract termination will find thousands of private plants cluttered with useless government-owned machines—also war products, goods in process and raw materials. This stuff must not block reconversion for months, sitting on the track of progress waiting for some inventory checker from Washington. Somebody must get tough, slash red tape, negotiate quick settlements on rough-checked inventories, set up warehouses for government property, let industry move the stuff out and get going.

## RECONVERSION

If government does its part by quick dollar settlement of terminated contracts, and rapid clearance of public property from private floors, American industry will match its amazing war-production performance with a new miracle of speedy reconversion to automobiles, washing machines and other peace-time products. How fast this job is done may determine our way of life for years to come. We can survive the poison of six months of confusion and unemployment, but slower conversion would invite dangerous political tinkering with our economic machinery. So let's give industry a chance to move fast.

## POSTWAR PROBLEMS

Looking beyond the war's end, we see a national budget of 20 billion dollars, prices perhaps 40% above pre-war, a very high general level of production and business, reasonably full employment, taxes lower than now, but higher than pre-war. In this new era two things will count most: (1) a consistently strong economic and military foreign policy that will protect the world from international gangsters, (2) a home policy that will leave the well-run business more profit (after taxes) than the bungled business, and permit a good worker to earn more than a dub. Without incentive rewards for foresight and sweat, the America we know will die.

# New Kilowatts Mill Ore For Utah Copper

Fig. 1—An integrated 850-psi 900-F condensing electric-generating plant serves high load factor Arthur and Magna mill demands for grinding copper ore

***High above the floor of Salt Lake valley a single-turbine two-boiler power station supplies 50,000 kw for milling a third of the nation's precious copper ore supply. Here are highlights of an interesting new condensing power installation located far from flowing cooling-water for heat rejection***

By E J FRANKLIN
*Consulting Mechanical Engineer*
*For Utah Copper Co*

*As told to Associate Editor* S A TUCKER

► Copper mining and milling operations at Garfield, Utah, one of the world's largest strip mines, require more than 25,000 kw of high-load-factor power at each of two mills for crushing and pulverizing ore, and another 18,000 kw for electrified machinery at the mine. Major part of this load, previously served from local utility lines, will be carried on a new condensing steam station burning pulverized coal and natural gas. The power station is entirely dependent on atmospheric cooling towers for rejection of low-level heat.

Plans for the steam plant, undertaken before limitation of materials due to wartime shortages, called for three 25,000-kw main turbines and two 5000-kw house sets. By arrangement with WPB, only one turbine of 50,000 kw has been installed for the duration of the material shortage. Two of the projected three boilers are now in place and have sufficient capacity to supply the single turbine.

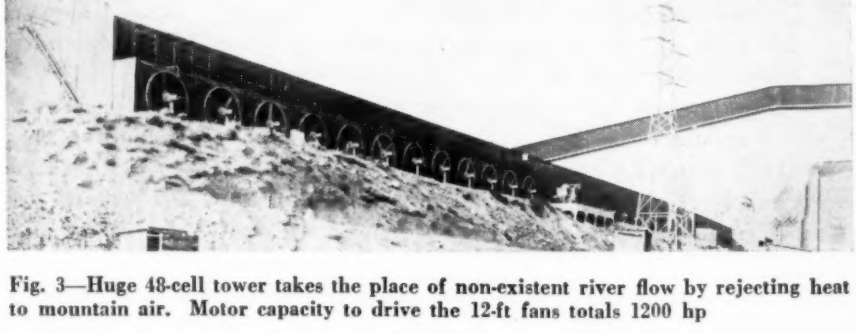


Fig. 3—Huge 48-cell tower takes the place of non-existent river flow by rejecting heat to mountain air. Motor capacity to drive the 12-ft fans totals 1200 hp

Ore comes about 30 miles by rail from strip mines in Bingham Canyon. At the two mills, ore containing less than 1% metallic copper is crushed and pulverized for concentration by a flotation process. Only concentrate goes to the smelter, tailings are washed into a diked area adjacent to Salt Lake. In addition to war-precious copper, molybdenite recovery in the two mills is second largest in the country and the mere trace of gold in original ore is sufficient to rank the mine as the largest producer of the yellow metal in Utah.

Coal from central Utah enters the plant on the uphill side of the boiler house. Elevated by inclined belt from a track hopper to the top floor of the boiler house, it is handled by flight conveyor to steel bunkers. Natural gas is piped to the plant but the supply available will be limited for the duration of war.

Two direct-fired radiant-type boilers are each fired by six cross-tube combination coal and gas burners. A single vane-controlled motor-driven forced-draft fan supplies combustion air to each steam-generating unit. Each boiler exhausts to a separate concrete stack through a hydraulic-coupling controlled induced-draft fan. A spare induced-draft fan between the present two boilers has no speed control.

The boiler-room arrangement has been little disturbed from the original plans by wartime material restrictions. Main steam leads from the two boilers have been brought to a common connection near the turbine throttle instead of leading directly to individual turbines. Feedwater heaters, deaerating equipment and evaporators have been installed in three sets just as planned for the original three turbine units.

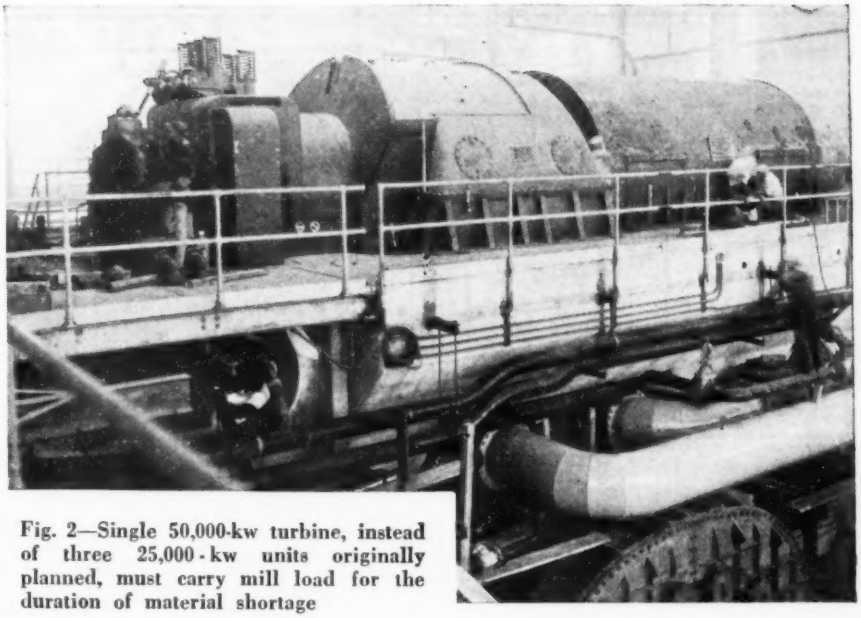


Fig. 2—Single 50,000-kw turbine, instead of three 25,000-kw units originally planned, must carry mill load for the duration of material shortage

The feedwater heating arrangement utilizes two sets of stage heaters in parallel. These, each originally purchased for 25,000-kw turbines, have sufficient combined capacity to serve the single larger machine.

Main condensate from the condenser hotwell flows down a barometric loop into a lined concrete hotwell so that condensate pumps operate under a positive suction head. A condensate booster pump operates at certain loads for which over-all economy dictates an increase in deaerator pressure above that provided by the surge tank at roof level. This surge tank provides an unusually large quantity, 220,000 gal, of stored condensate because of lack of nearby supply of satisfactory boiler-feed makeup.

Boiler makeup and other domestic water comes from the Garfield water system deepwells. A 6000 gal-per-hr hotflow softener recirculates sludge from lower cone to hot-process tank to increase deposition of solids. Two 66-in. carbonaceous filters follow the softener. All makeup is then evaporated.

Makeup for the cooling towers comes by canal from Lake Utah several miles away. High in total solids and hardness, this water passes through either of two 35-ft diameter concrete cold lime-soda softeners before being introduced into

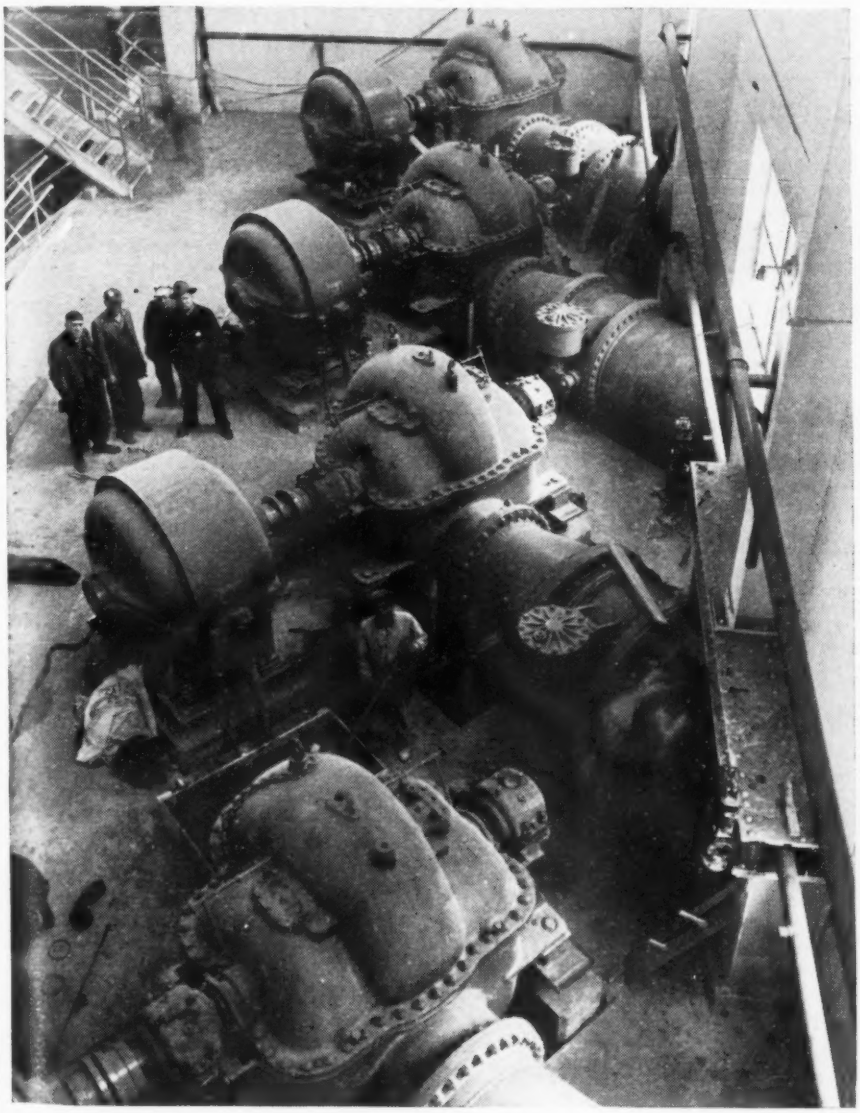


Fig. 4—Battery of circulating pumps in main turbine room raises circulating water uphill to cooling towers. Flow returns through condenser to pumps by gravity

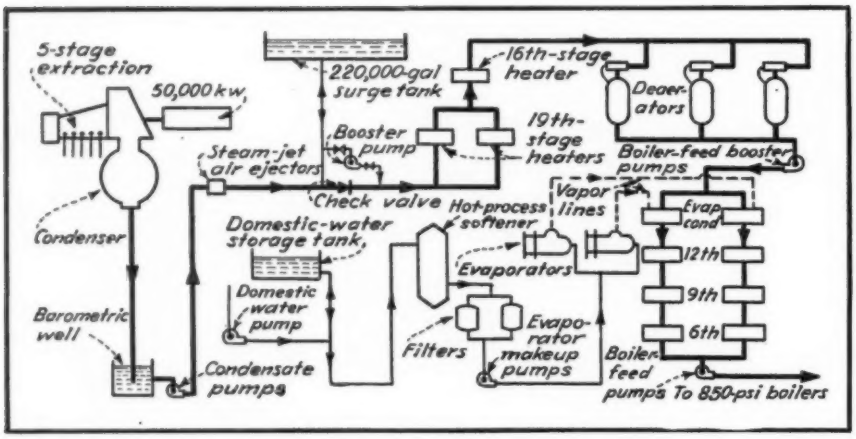



Fig. 5—Five-stage feed-heating system employs two sets of stage heaters to supply a single turbine totaling the same capacity as two units originally planned

the cooling circuit. Eight million gallons of treated water storage is provided by existing concrete tanks once used for mill processes. Nalco products are used and the Flox Co of Minneapolis acts as consultant in connection with all water treating problems.

The 48-section main cooling tower, located some 32 ft up the hillside above condenser level, provides sufficient gravity head to overcome friction losses through the condenser and maintain a positive head on the suction of four main circulating pumps. Butterfly valves isolate the two circuits of the divided water-box main condenser; similar valves in suction and discharge of each circulator pump permit running as many

## *Central Power Station — Utah Copper Company*

## PRINCIPAL POWER P

### *COAL AND ASH HANDLING:*

Belt and flight conveying equipment.....Link-Belt Co
Coal received in hopper bottom cars in proper size for pulverizing. Unloaded in storage yard or directly in to track hopper. Thence by belt conveyor to power plant, distributed into overhead bunkers by flight conveyor; thence, by gravity to pulverizers

Belts, canvas, rubber lined.....American Rubber Mfg Co
6 ply, 32 oz 36 in. and 5 ply, 32 oz 24 in.

Weighers, 6 (3 per boiler).....Richardson Scale Co

Bindicators.....The Bin-Dicator Co

Hydrojet system.....Allen-Sherman-Hoff Co
Slag handling and flue-dust removal equipment

### *BOILERS, FURNACES AND AUXILIARY EQUIPMENT:*

Boilers, 2, radiant type.....Babcock & Wilcox Co
Heating surface 12,690 sq ft, design pressure 950 psi gage, steaming capacity 350,000 lb per hour at 875 psi gage, 905 F, furnace volume 16,430 cu ft

Superheaters.....Babcock & Wilcox Co
Continuous tube, counter flow each 10,973 sq ft

Waterwalls.....Babcock & Wilcox Co
Heating surface each 5,477 sq ft

Air Heaters—tubular.....Babcock & Wilcox Co
Heating surface each 49,257 sq ft

Economizers.....Babcock & Wilcox Co
Continuous tube, counter flow, each 15,900 sq ft

Pulverizers.....Babcock & Wilcox Co
3 per boiler, size E-50, Class 221BA, direct firing

Burners, 6 per boiler.....Babcock & Wilcox Co
Coal and gas, cross-tube type

Induced-draft fans.....B F Sturtevant Co
2 primary, 1 auxiliary, No. 1010TVID, DWDI

Hydraulic couplings, 2, for i-d fans.....American Blower Corp
No. 42, Class III, Variable speed

Forced-draft fans.....B F Sturtevant Co
2, No. 135 design 9 turbovane DWDI

Mill-seal blowers.....Allen-Billmyre Corp

Smoke flues and ducts, steel.....Babcock & Wilcox Co

Stacks—3 concrete.....Alphons Custodis Chimney Construction Co
139-ft high, 10-ft diameter at top, 30 ft of brick lining

Water columns.....Diamond Power Specialty Co
2 per boiler, forged steel with bi-color gauges

Safety valves—Consolidated.....Manning, Maxwell & Moore

Non-return valve.....Edward Valve & Mfg Co
12-in. Edwards No. 3505Y

Power-control valves, Ashcroft.....Manning, Maxwell & Moore

Soot blowers.....Diamond Power Specialty Co

Evaporators.....Foster Wheeler Corp
Single-effect Type HP submerged coil

Evaporators.....Foster Wheeler Corp

Closed feedwater heaters.....Foster Wheeler Corp

Deaerating heaters.....Elliott Co
Horizontal, 339,480 lb. per hour

Water-conditioning system.....Infilco, Inc
1, H-60 hot-flow softener for boiler-feed water, 6000 gal per hr

### *TURBINE AND AUXILIARIES:*

Turbine-generator.....General Electric Co
One 50,000-kw, 0.8 pf, 21 stage, 3600-rpm, 13,800-volt, 3-phase, 60-cycle, hydrogen-cooled, tandem-compound, double-flow, with gear-driven exciter and pilot exciter

Condenser.....Allis-Chalmers Mfg Co
One 50,000-sq-ft horizontal, single-pass divided water-box type surface condenser, condensate removal, barometric drain without the conventional condensate pumps, gravity flow to barometric well

Water conditioning for circulating water.....Infilco, Inc
2, V-2000 Accelerator softeners, capacity each 250 to 2000 gpm

Cooling Towers.....Foster Wheeler Corp
One forced-draft cooling tower consisting of 48 cells with 48 twelve ft fans driven by 25 h.p. motors. One forced-draft cooling tower consisting of 3 cells for station-service cooling water

Traveling screens.....Link-Belt Co
2, Style E water intake screens up run spray

### *PUMPS:*

Boiler-feed pumps.....Ingersoll-Rand Co
3 motor-driven, 1 turbine-driven, units. Each unit consists of one No. 5HT, 4-Stage Cameron, capacity 1165 gpm, 1890-ft head and one No. 4GT, 2-stage booster pump, 1100 gpm, 1100-ft head mounted on a common bed plate with single drive.

Turbine Drive.....Westinghouse Electric & Mfg Co
One 1000-hp impulse, "CH-25", consisting of one 2-row Curtis element, direct connected to pump

Condensate-circulator pumps.....Allis-Chalmers Mfg Co
3, 6 in. x 5 in. type SJ horizontal centrifugal pumps capacity each 1000 gpm, 215-ft head

Condensate-booster pumps.....Allis-Chalmers Mfg Co
3, 6 in. x 6 in. Type SF horizontal centrifugal pumps capacity each 1200 gpm, 100-ft head

Condenser circulating-water pumps.....Allis-Chalmers Mfg Co
4, 42 in. x 36 in. Type LS centrifugal pumps, capacity each 35,000 gpm, 50-ft head

Domestic-water pumps.....Ingersoll-Rand Co
3, size 2, MRV40, capacity each 300 gpm, 275-ft head

Cooling-tower makeup pumps.....Allis-Chalmers Mfg Co
3, 8 in. x 8 in. Type SF centrifugal pumps, capacity each 2000 gpm, 80-ft head

Evaporator—makeup pumps.....Allis-Chalmers Mfg Co
4, 2 in. x 1½ in. Type SSMH, capacity each 30 gpm, 250-ft head

Accelator makeup pumps.....Allis-Chalmers Mfg Co.
3, 10 in. x 8 in. Type SH, capacity each 3000 gpm, 200 ft head

Station-service circulating pump.....Allis-Chalmers Mfg Co
3, 8 in. x 8 in. type SF capacity each 2000 gpm, 120-ft head

Heater drip pumps.....Allis-Chalmers Mfg Co
4, 4 in. x 3 in. type C2S, capacity each 90 gpm, 78-ft head

Ash-sluice pump.....Allen-Sherman-Hoff Co
1, 8 in. x 8 in. frame C-5 recirculating pump

Fire pump.....Dayton-Dowd Co
1, size 5AF-10, capacity 1000 gpm, 289-ft head

Boiler—test pump.....Worthington Pump & Machinery Corp
1, size 1 in. x 4 in. 1845 VTSA power pump capacity 5.7 gpm, 2500 psi head

of the four pumps as required by load and atmospheric conditions.

All main auxiliaries, except one boiler-feed pump, are motor driven. Auxiliary power at 2300 and 440 v is taken from the 44-kv yard through duplicate transformer banks and air-break switching equipment. Two separate dc systems, each supported by its own storage battery, supply control circuits and valve operators.

When completed, the power plant will contain upwards 110,000 kw for supplying the two ore mills, mine machinery and possibly electrification of the 30-mile ore railroad. Operation will be under the direction of H P Early of the Utah Copper Co.

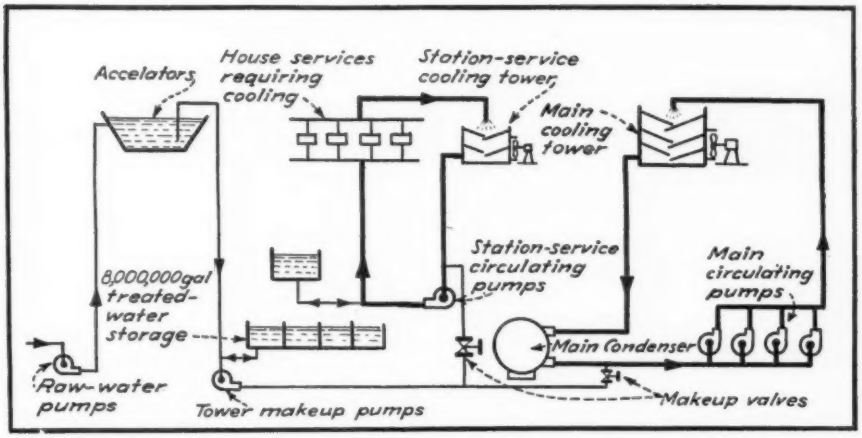



Fig. 6—Main condenser cooling circuit is served by 48-section cooling tower. Auxiliary house service cooling water comes from separate tower installation

# PLANT EQUIPMENT

*E J Franklin—Consulting Mechanical Engineer*

Screen-washing pumps.....Allis-Chalmers Mfg Co
2, 2½ in. x 2 in. type DH, capacity each 180 gpm, 150-ft head

Air-driven sump pump, Size No. 25.....Ingersoll-Rand Co

*AIR COMPRESSORS:*

Air compressors for control equipment.....Chicago Pneumatic Tool Co
2 motor-driven, 1 Hercules engine driven. 12 in. x 13 in. Class TB horizontal, single-stage, double-acting, water-cooled, carbon-ring. Capacity each 306 cfm 125 psi gage.

Air compressor for station service.....Ingersoll-Rand Co
1, 12 in. x 5½ in. class XOB dublex, two-stage, capacity 350 cfm, 125 psi gage (12 in. x 5½ in. x 12 in.)

*PIPING AND VALVES:*

Station piping.....Midwest Piping & Supply Co
Includes all piping except condenser circulating-water piping, high-pressure steam and boiler-feed piping, carbon moly, all welded.

Condenser circulating-water piping.....Kansas City Structural Steel Co
Welded steel

High-pressure steam and water valves.....Crane Co

Extraction reverse-current valves.....Atwood & Morrill Co

Blowdown valves, tandem assembly.....Yarnall-Waring Co

Check valves, tilting disk.....Chapman Valve Mfg Co

Feedline stop-check valve.....Edward Valve & Mfg Co

Boiler-feed control valves.....Bailey Meter Co

Natural-gas control valves.....Ruggles-Klingemann Mfg Co

Rubber seated butterfly valves.....Henry Pratt and Co
Condenser circulating-water system, 72 in. to 24 in.

Sluice gates at cooling towers.....Chapman Valve Mfg Co
72 in. and 24 in.

Traps.....Yarnall-Waring Co

Forged-steel valves.....{ Chapman Valve Mfg Co / Manning, Maxwell & Moore

Atmospheric-relief valves.....Atwood & Morrill Co
2 30 in.

Heat insulation for pipes and ducts.....Johns-Manville Corp

Rubber expansion joints.....U. S. Rubber Co

*METERS AND CONTROLS:*

Automatic controls.....Bailey Meter Co
Combustion, temperature, flow, pressure and level controls with indicating and recording instruments

Three-element feedwater control.....Bailey Meter Co

Turbine supervisory instruments.....General Electric Co

Conductivity recorders.....Leeds & Northrup Co

Boiler, turbine and pump control panels.....Bailey Meter Co

*ELECTRICAL EQUIPMENT:*

Transformers.....Westinghouse Electric & Mfg Co
3 36,000 kva, 13,800 to 44,000 volts
2 auxiliary 7500 kva, 44,000 to 2300 volts
2 2500 kva, 2300 to 480 volts
2 1250 kva, 2300 to 480 volts

Lightning arresters.....Westinghouse Electric & Mfg Co

Oil circuit breakers.....Westinghouse Electric & Mfg Co
Type GO-3, rated voltage 46,000, amps 1200, 3-phase 60-cycle

Outdoor disconnect switches.....Westinghouse Electric & Mfg Co

Control and relay boards.....General Electric Co

Auxiliary-power boards.....Westinghouse Electric & Mfg Co

Storage batteries.....Electric Storage Battery Co
2, Exide-chloride batteries, Type FM-9 each of 60 cells—72 hr capacity, 448 ampere hours

Motor-generator battery charger.....Westinghouse Electric & Mfg Co
1, 5-kw, SK generator with 7½-hp Type CS motor

Spare exciter motor-generator set.....General Electric Co
1, 200-kw, 250-volt, type OD-1549Y generator driven by 300 hp type K motor

Motors for boiler-feed pumps.....General Electric Co
3, 1000 hp type KF

Motors for induced-draft fans.....General Electric Co
3, 1000 hp type K

Motors for forced-draft fans.....General Electric Co
2, 500 hp type K

Motors for pulverizers.....General Electric Co
6 150 hp type KG

Motors for circulating-water pumps.....Allis-Chalmers Mfg Co
4 600 hp

Motors for all Allis-Chalmers Pumps.....Allis-Chalmers Mfg Co

Miscellaneous small motors.....{ General Electric Co / Westinghouse Electric & Mfg Co

Motor operators for valves, Limitorque.....Philadelphia Gear Works

*MISCELLANEOUS:*

Structural steel for buildings.....Kansas City Structural Steel Co
Including tanks, floor grating, stairs and hand railing

Structural steel outdoor electrical station.....American Bridge Co

Turbine-room cranes.....Harnischfeger Corp
2, 50-ton, electric traveling cranes

Elevators.....Westinghouse Electric Elevator Co
Combination passenger and freight 2, 3500-lb, 250 fpm

Auxiliary turbine-room hoist....Wright Mfg Div, Am Chain & Cable Co
1 40-ton, ball bearing, Ford tribloc hoist

Miscellaneous hoists and trolleys..Wright Mfg Div, Am Chain & Cable Co

Dust control, coal bunkers.....Western Precipitation Co
2 type 6VG, size 10-5 multiclone units

Fire hydrants.....Ludlow Valve Mfg Co

Fire-fighting equipment.....{ Walter Kidde Co / Viking Automatic Sprinkler Co

Window sash and small doors.....Detroit Steel Products Co

Rolling doors.....Kinnear Mfg Co

Interior partitions, Transite.....Johns-Manville Corp

Oil storage and purifying equipment.....Bowser, Inc

Plumbing fixtures.....Crane Co

Unit heaters.....American Blower Corp

Domestic-water heaters.....American District Steam Co

Water coolers and fountains.....Frigidaire Div

# Mix Surplus Anthracite Barley With Bituminous to Stretch Supply

***Experience indicates mixtures up to 80% anthracite are practical; improved combustion results in some cases. E E Finn, consulting engineer, Anthracite Industries Inc, reviews recent tests, shows how to find out which mixture works best in your plant, and describes practical mixing methods***

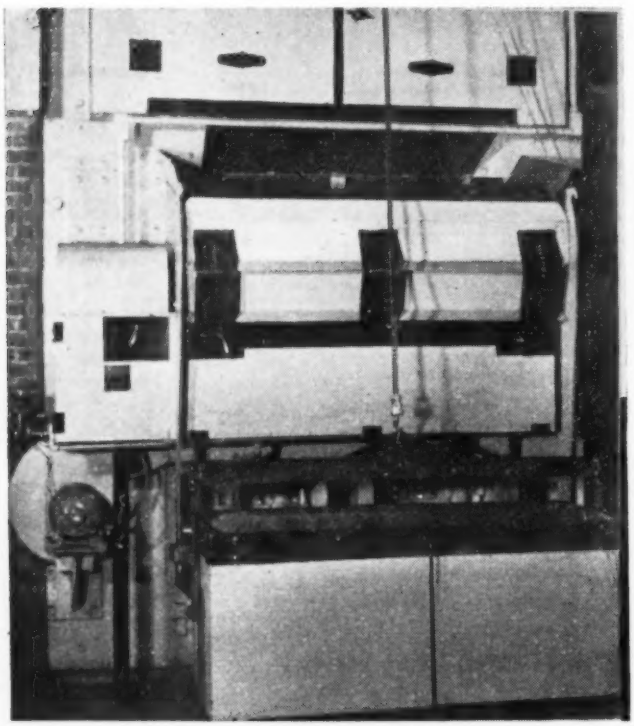
► THIS WINTER barley anthracite stands out as the only fuel of which there is a surplus and Solid Fuels Administrator Harold L Ickes suggests that it be used to "stretch" supplies of bituminous. Individual consumers may determine whether their installations are suitable for burning advantageously a mixture of bituminous and anthracite and Administrator Ickes says the Solid Fuels Administration is prepared to assist with technical advice.

Why is there a barley surplus? This fuel, also called No. 3 buckwheat, originates as a byproduct from breakage of larger anthracite sizes. After this accidental beginning all resemblance to a byproduct ceases as the modern concentrator table and other equipment which cleans barley can prepare it to any reasonable specifications of size and ash content.

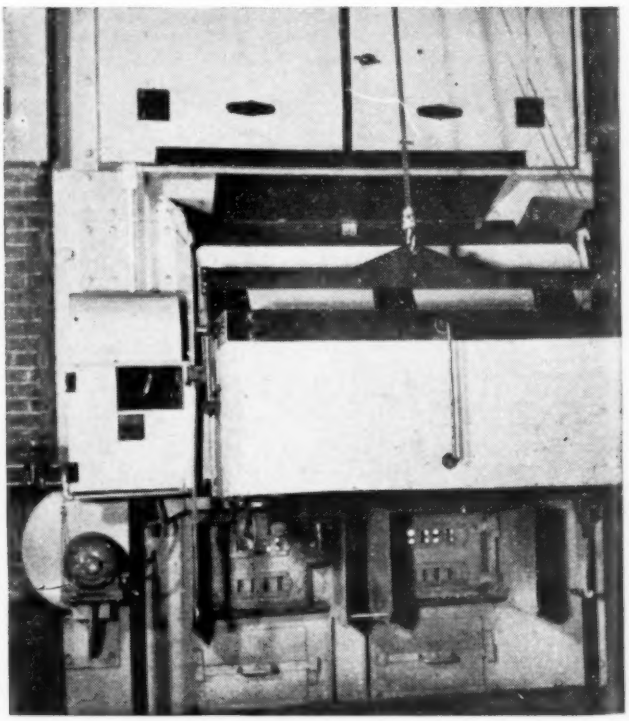
Because demand for larger domestic sizes increased without corresponding industrial absorption, barley production now exceeds consumption by several thousand tons a week, creating substantial stockpiles at mines. On the average, 9% of all anthracite produced is barley. It is not affected by priority delivery orders.

Why mix barley with bituminous? Barley can be burned alone on suitable equipment (POWER, Mid-Dec 1943, pg 90) but mixing it with bituminous permits use in a much wider range of installations. Furthermore, recent tests and experience show that such mixtures may give better results than bituminous alone, particularly where wartime conditions prevent purchase of needed quality or size.

Bureau of Mines tests at the hospital-unit plant, Camp Kilmer, Stelton, N. J., showed satisfactory performance with mixtures ranging from 33% up to and including 80% anthracite. This plant's equipment consists of three 5190-sq-ft



**At Chester County Hospital, West Chester, Pa., a spreader stoker fires a 50-50 mixture of anthracite barley and ⅝-in. bituminous. Mixing begins at delivery; alternate tons of barley and bituminous are dumped into bins until they are full. Photos show the simple coal and ash-handling setup**



**Further mixing occurs when coal is shoveled into this truck, which carries, on its bottom, caster wheels for easy travel from bin to bunker. Each side has a bracket with a roller; these ride on guide rails on each side of the boiler front. Guide rails keep the truck clear of projections during lift**

Titusville watertube boilers, designed for 125 psi and operating at 100. Stokers are Detroit single-retort underfeed units, with moving grates and side dump plates; two are steam and one motor driven. Auxiliary equipment includes Clarage forced- and induced-draft fans, V-belt driven from two steam turbines and an electric motor.

Two types of bituminous nut-and-slack averaged 12,500 Btu per lb as received, with 23% volatile matter. Mixtures with 40, 60 and 80% barley anthracite gave comparable load-carrying capacity with no economic losses. Smoke elimination improved progressively as larger percentages of anthracite were introduced.

From test data, engineers in charge determined that a 50-50 mixture was best for this plant. Following two weeks of operation by regular plant personnel, managing officers reported that slicing of the fire was definitely easier, clinkers were eliminated and firemen thought the mixture a good fuel.

Bureau of Mines engineers conducted another test at Richards Chemical Works, Jersey City, N. J. Here equipment included a battery of four Keeler brick-set hrt boilers, with Link-Belt open-hopper bituminous stokers having separate fan and motor units. Bituminous coal for the tests, ½x1¼-in. nut, double screened, ran 13,500 Btu per lb as received and 34% volatile.

Burning straight bituminous at full load set up test data for comparative purposes. Mixtures with 33, 50, 66 and 80% barley were then burned at the same load. Results proved completely satisfactory to the plant engineer and boilers now fire a 50-50 mixture.

### *How Combustion Improves*

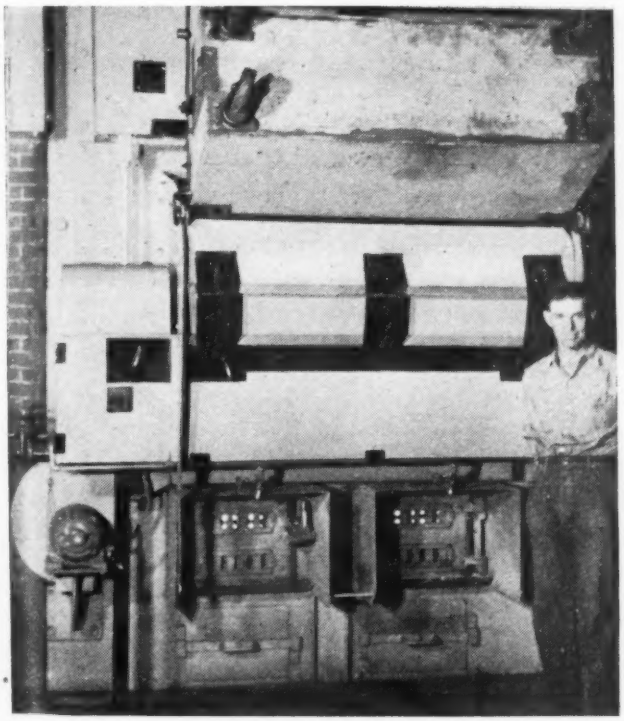
Why should mixing barley with bituminous improve combustion in many cases? For one thing, volatile combustible matter in anthracite is so low as to be negligible. The approximate rate at which volatile matter distills from a given bituminous coal tends to decrease in proportion to the amount of anthracite mixed with it. This leads to more complete combustion of volatile gases and thus means less smoke. Secondly, anthracite does not coke and thus adding barley to bituminous weakens the coking strength of the mixture. On hand-fired grates slicing the fire becomes easier and on stokers the agitating elements have less trouble breaking coke formations to keep the bed open.

Mixing barley with bituminous may be likened to adding tetraethyl lead to gasoline. Just as an engine knocks and loses power when gasoline falls below the required quality, so a fuel bed clinkers and smokes when coal characteristics get out of line with equipment needs. Adding tetraethyl lead to the gasoline changes its knock characteristics and thus permits the performance for which the engine was designed. Adding barley alters the volatile and coking characteristics of the fuel, bringing it back to the level required for good performance. Thus major improvement from addition of barley may be expected where wartime conditions force use of bituminous coals unsuited for the existing firing equipment.

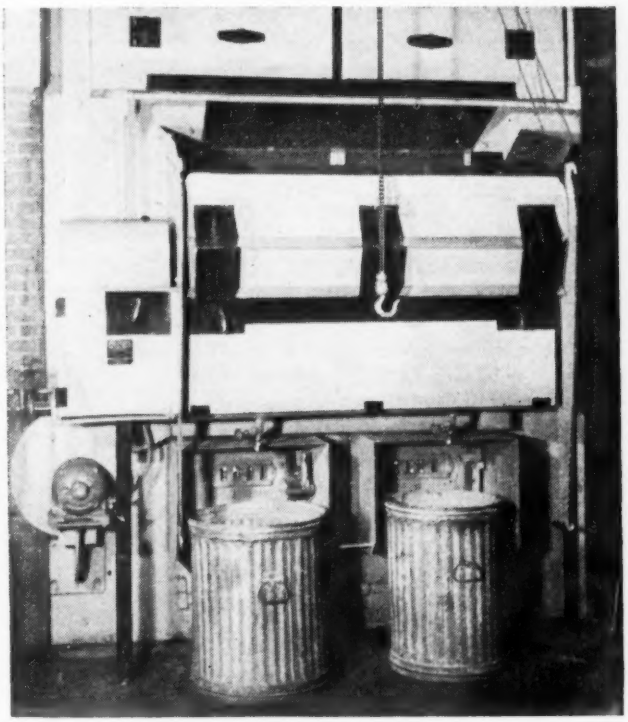
What mixture should be used? With medium or high-volatile bituminous coals, start with a mixture of about 25% barley. Try this long enough for operators to become familiar with its use and to check performance under heaviest load conditions. If, as it should, this mixture works well, try a higher percentage of anthracite; many plants secure best results with mixtures running about 40 to 60% anthracite. Mixing anthracite with low-volatile bituminous may prove satisfactory in some cases but trial mixtures should not exceed 10 or 15%.

How good a mixture is needed? This depends on several factors. The smaller the size of bituminous and anthracite the easier it is for bituminous particles

(*Continued on page* 172)



At the top, rollers hit the end of the guide rails and continued hoisting tips the truck, dumping coal into the hopper. Lifted truck reveals apron extensions around each fire door and spray nozzles above each, installed to eliminate the dust nuisance formerly connected with pulling ash to the floor



With cans, or a truck, in place beneath apron extensions and with water sprays in operation, the fireman can pull ash or clinker through the doors and directly into the containers. Dust or steam arising is drawn back into the boiler, keeping the boiler room and the hospital free from annoying dust

# You Can Pack Centrifugal Pumps To Hold High Pressure and Temperature

***Hugh Platt, service engineer, Byron Jackson Co, presents solutions to some problems found when packing high-pressure high-temperature centrifugal pumps used for boiler-feed and oil-refinery service***

▶ MANY AND VARIED are the problems of selecting and installing packing in centrifugal pumps. One factor is the kind of liquid pumped and, in general, the higher its pressure and temperature, the more difficult the packing job and the more care needed in selecting and installing packing.

Common types of packing and their applications may be classified as:

1. *Braided cotton.* For low-pressure cold-water service. It generally contains a graphite or tallow lubricant and does not become hard and abrasive when given proper care in service.

2. *Braided asbestos.* For moderate temperatures and pressures for water and distillates. Asbestos packing is frequently made with a graphite lubricant, but is specially treated for pumps handling solvents. It tends to become hard in water service as its lubricant works out.

3. *Molded plastic asbestos with a rubber, Neoprene or other binder.* Usually used with metallic packing for corrosive liquids, light distillates or hot oil or water, particularly if leakage is to be kept at a minimum.

4. *Lead foil with a resilient core of asbestos or rubber, or solid, pressed foil without a core.* Used alone or with plastic or soft packing. For applications where temperature of the liquid pumped does not exceed 350 F when the stuffing box is adequately cooled by liquid circulated through a jacket around it or through the lantern ring.

5. *Aluminum, copper or phosphor-bronze foil.* Similar to lead-foil packings, but frequently made without a core. Use this packing only when temperature of the liquid pumped exceeds 350 F because it tends to cut even hard-surfaced shaft sleeves.

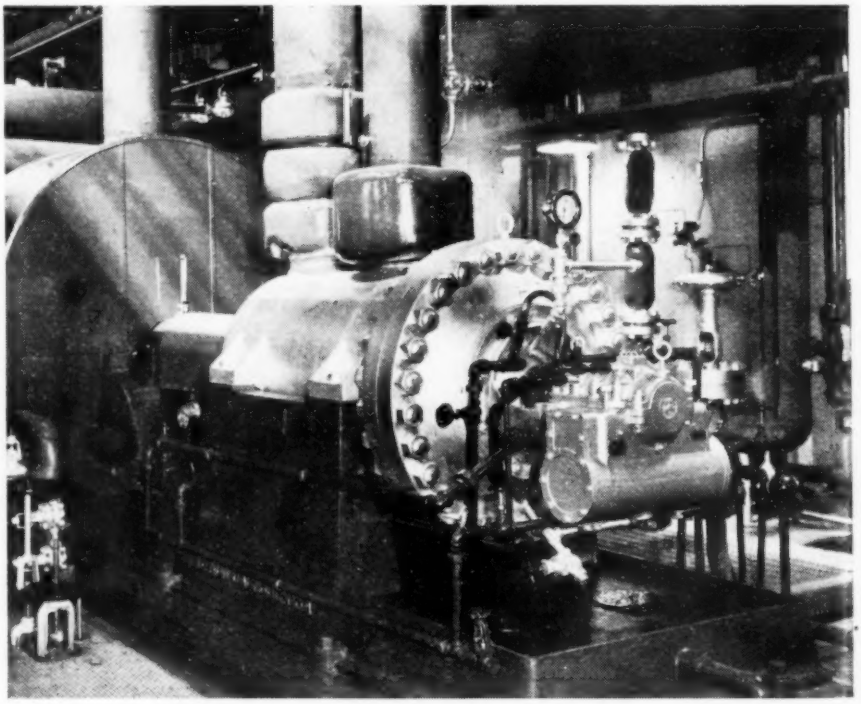
A great many designs of these five packings give excellent service if properly installed and maintained in applications to which they are suited.

Graphite in packing, particularly in water service, has caused electrolytic corrosion of the metal it contacted in idle equipment. Generally in normal operation this action on equipment is not serious. It is particularly noticeable in valve-stem packing after valves have been tested with water and put in stock without removing packing. This is one reason for packing the stuffing boxes of pumps in the field rather than before shipping.

Rings of packing in a stuffing box may be considered as a multiple seal. Under ideal conditions each ring would take its share of the pressure inside the pump at the stuffing box. For example, in Fig. 1, if the inside pump pressure is 120 psi then the ideal packing job would have 20-psi drop across each of the six rings. To lubricate the packing, slight leakage should occur along the shaft.

Unfortunately, packing does not always perform that way particularly on high pressures. Under some conditions pressure between the bottom of the stuffing box and the packing compresses it against the gland, as in Fig. 2. The packing ring next to the gland may then be pressed so hard on the shaft as to stop all leakage, as shown. When this happens it does no good to ease off on the gland because pressure at the bottom of the stuffing box keeps the packing compressed against the gland and shaft so that leakage does not start. As a result, the packing ring next to the gland overheats and burns, and scores the shaft sleeve.

This condition results from the pack-



**This steam-turbine-driven 1550-gpm high-pressure 7-stage centrifugal boiler-feed pump operating with 125-psi 350-F suction conditions and 1550-psi discharge pressure presents real packing problems to prevent excessive leakage with reasonable long packing life and a minimum of wear on the shaft sleeve**

ing being too plastic for the pressure under which it operates. Sometimes pressure builds up between the outside of the packing and the stuffing-box wall and forces the packing onto the shaft, as in Fig. 3. The packing rings nearest the bottom of the stuffing box then tend to turn with the shaft and may become twisted. Such conditions have at times made it necessary to repack the pump completely.

To overcome these difficulties in high-pressure stuffing boxes a graduated packing arrangement is frequently used. In applications of this kind the denser packing is placed in the bottom of the box and the softer nearest the gland, Fig. 4. When packing is installed this way the internal pump pressure does not compress the rings sufficiently next to the gland to shut off all leakage, as in Fig. 2.

When hard and plastic packings are combined it is common practice to alternate metal-foil packing with a more plastic form. A metal ring is always placed at the bottom of the stuffing box to prevent the first plastic ring extruding through the throat bushing. The higher the pressure, the fewer plastic rings used, until for very high pressures there is only one, placed next to the foil ring in the bottom of the box, as in Fig. 5.

When pressures are excessively high a denser foil packing may be used next to the gland than in the remainder of the stuffing box—for example, lead foil and plastic in inner part of the box, and next to the gland, phosphor bronze or copper foil. For metal packing use a hardened or hard-surfaced sleeve on the impeller shaft in the stuffing box. Never use a bronze shaft sleeve with packing containing lead because it tends to wipe onto the bronze, and builds up.

### *Use of Sealing Liquid*

Frequently, when the pressure or temperature, or both, at the stuffing boxes is high, it may be necessary to circulate a sealing liquid through the lantern rings to absorb heat and to provide lubrication of the packing. Under these conditions it is advisable to place a ring of metallic packing on each side of the lantern ring irrespective of the type of packing used for the other rings. In petroleum refineries and other processes, pumps handling light volatile liquids often have sealing-oil systems on the lantern rings. With these systems the packing has to hold the sealing oil in the lantern ring only. This oil also provides additional lubrication for the packing and absorbs heat. Three general arrangements of these sealing systems are:

*1. Deadend system with higher pressure on lantern ring than on packing from inside pump, Fig. 6, so that there is always leakage into pump as well as out through gland.*

A small rotary pump, or pressure lubricator, may supply the sealing liquid. Only 40 to 60 drops per minute per stuffing are required if packing is properly selected and installed. A high-viscosity sealing oil should be used, but its viscosity depends to a degree upon how much contamination of the pumped liquid can be permitted. If a rotary pump serves several stuffing boxes requiring different pressures, a differential-pressure valve may be needed at each box to regulate pressure in the lantern rings to the proper value above that inside the pump, thus controlling the leakage through the packing to a reasonable value.

*2. Sealing-fluid system circulating some of pumped liquid through lantern ring at higher pressure than on packing from inside pump, Fig. 7.*

When sealing and cooling of packing are needed, circulate the cooling fluid through the lantern ring. This cools the shaft directly and is much more effective than circulating liquid through jacket around outside of stuffing. This system is also recommended for cool, light distillates if only slight leakage is allowed through packing into pump. Any pumped liquid that gets into the lantern

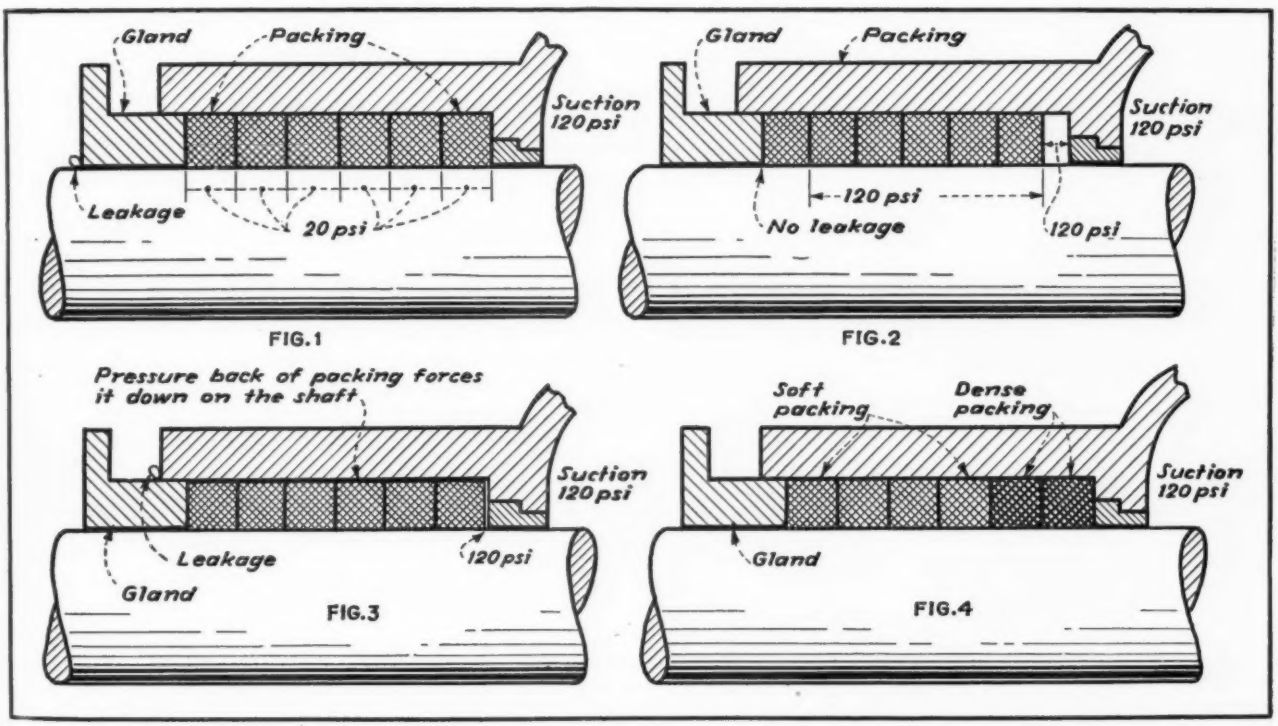



Fig. 1—In an ideal packing job, total pressure on the packing would divide equally across each ring. Fig. 2—Sometimes total pressure inside the pump may build up in the stuffing box bot om and compress the packing against the gland. Fig. 3—Packing may be compressed on the pump shaft with leakage flow outside instead of inside the packing. Fig. 4—In some high-pressure stuffing boxes a graduated packing arrangement has given best results with the denser packing in the stuffing-box bottom

ring is carried through with sealing oil and does no harm. If a highly volatile liquid leaked out of the pump into the lantern ring of a deadend system, and flashed, pressure would build up that would blow the sealing oil out of system.

With the circulating, as with the deadend system, if a low-differential pressure must be maintained across the packing between lantern ring and bottom of stuffing box, provide a differential pressure valve to control this pressure separately from pressure back of the stuffing box. Where high-temperature liquids are pumped, circulate from 1 to 3 gpm of cooling liquid through the lantern ring, depending on temperature of liquid and size of pump. With cool, volatile liquids 0.3 to 1 gpm of sealing fluid should be sufficient to circulate.

*3. Sealing-fluid system maintaining pressure in lantern ring below that on packing from inside pump, Fig. 8.*

In a number of processes any contamination of liquid in pump accumulates; therefore, all leakage must be through packing and not inward from sealing-oil system. For such conditions install a differential-pressure regulation to maintain the pressure in the lantern ring 10 to 25 psi less than the pressure back of the packing. With this system be extremely careful when installing the packing to get the inside rings tight on the shaft before putting in the lantern ring. Care must also be taken to put in the proper number of packing rings to locate the lantern ring correctly. Allow for circulating 2 to 4 gpm of sealing oil per stuffing box. From the lantern-ring, discharge the sealing fluid into a tank with a vent large enough to flash off the oil's contaminations. A heater may be required in the sealing-oil tank to assist in driving off the light fractions, after which the oil is cooled on its way to the lantern-ring.

It is common practice with sealing-oil systems to use lead-foil packing for temperatures below 350 F and aluminum above 350 F. Copper or phosphor-bronze foil packings have given good results in place of aluminum for high temperatures and in place of lead for high pressures at normal temperatures. To reduce leakage out of or into the pump and out of the gland, a ring of plastic packing is installed between the metallic rings on both sides of the lan-

(*Continued on page* 140)

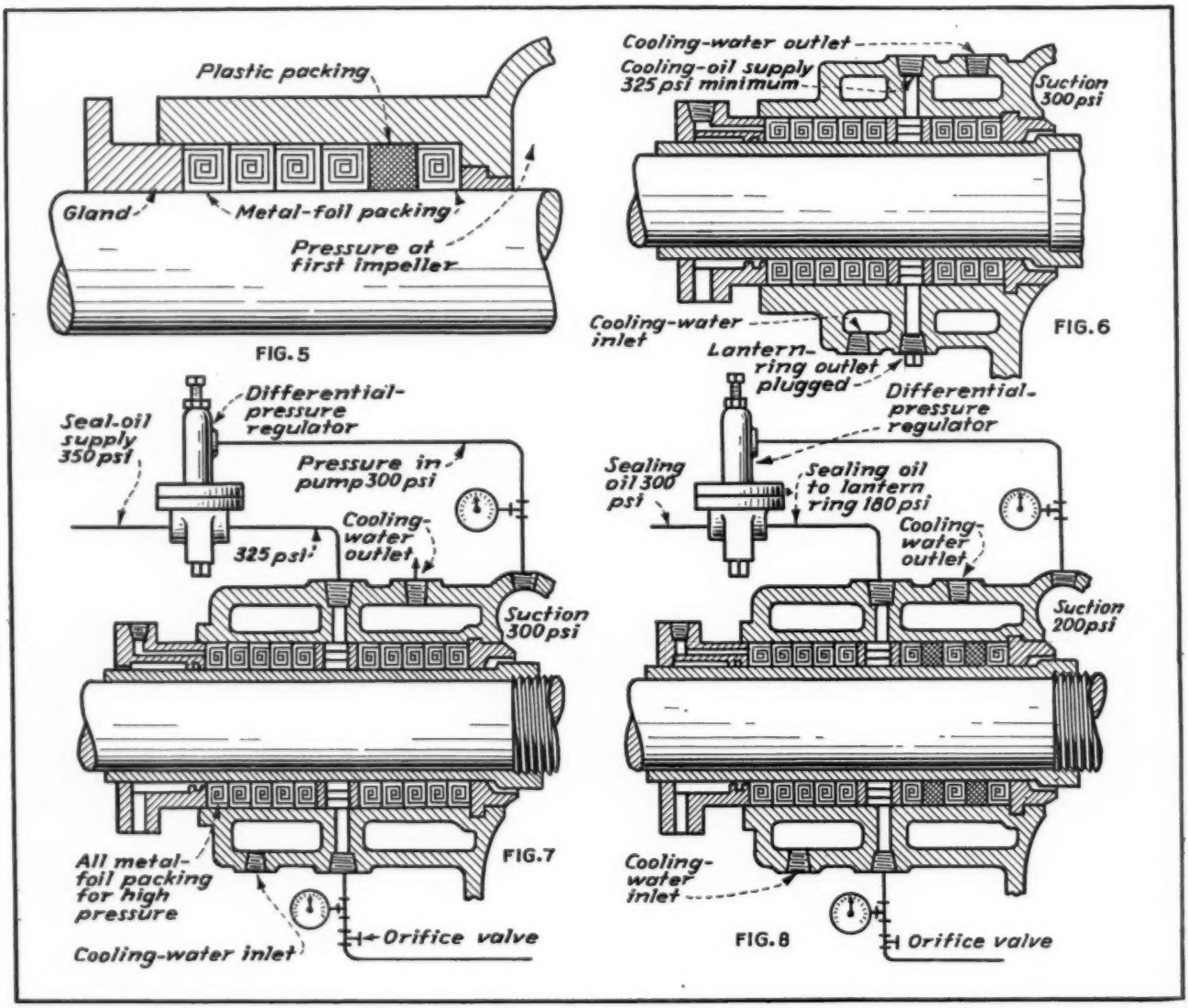



Fig. 5—On high pressures use only one plastic packing ring, placed next to a metal-foil ring in the bottom of the stuffing box. Fig. 6—Deadend sealing-fluid system with separate sealing fluid that maintains a higher pressure in the lantern ring than in the pump. Fig. 7—This sealing-fluid system circulates some of the liquid pumped through the lantern ring at a higher pressure than on the packing from inside the pump. Fig. 8—Sealing-fluid system maintains lower pressure in the lantern ring than on the packing from inside the pump so that leakage at all times is from inside the pump outward and not inward

# More Power for South America

***Stimulated by war-fuel shortages and industrial expansion, republics to the south plan hydro projects totaling more than a million-and-a half kw, while busy completing war-needed units***

By CHARLES A. HOWARD, *Technical Director*
*Inter-American Development Commission*

Map shows approximate location of projects mentioned in the text. Tremendous waterpower potentialities await development in Bolivia, Brazil, Chile and Peru

► STIMULATED BY WARTIME SHORTAGES of imported fuels and expansion of basic industries, South American republics plan postwar hydroelectric programs of major scope while engaged in completing such strategic projects as war needs dictate. Many of these republics have large unexploited sources of electric power, especially Brazil and the mountain republics along the Andes, such as Chile, which is 2600 miles long, seldom more than 100 miles wide and has mountains exceeding 20,000 ft in height.

In contrast with potential hydro resources and valuable mineral deposits, the continent of South America has extremely limited commercial sources of coal. Most of the deposits which do exist are either insufficient in quantity, poor in quality or badly located with reference to consuming centers. Thus, need for importing large quantities of fuel proves a heavy burden on the economies and finances of most South American countries, even in normal times. Now wartime shipping restrictions make the situation much worse. Coupled with war-stimulated industrial development, this naturally leads to stock-taking of potential hydroelectric resources and long-range planning.

### *Import Difficulties*

Difficulty of importing equipment from the United States and Europe now retards development of potential power resources in the other Americas. Only power projects most essential to production of strategic materials and civilian needs get equipment priorities. Some of these are shown in the accompanying photographs.

Both Chile and Uruguay have nationalized future production of electric power within their borders and plan for complete electrification of public services, industries and railroads. Long efforts to be free from necessity of importing coal and oil make Uruguay's electrification program one of the most advanced in South America.

Uruguay's best known water-power site stands right in the middle of the republic and only 150 miles from Montevideo. Begun in 1937, this 3800-ft dam on the Rio Negro impounds the largest artificial lake in South America. Reported to cost approximately $35,000,000, the project includes the dam, four generating units to develop a total of 128,000 kw and transmission lines. Started by a European contractor, work was interrupted by the war; a United States organization is finishing the job. One 32,000-kw turbine-generator will soon be installed at Rio Negro dam and a transmission line to Montevideo completed, relieving that city of some of its dependence on imported fuels.

Long-range Uruguayan plans also include (1) a dam on the Queguay just north of Paysandu, to develop 5000 kw (2) a dam on Arroyo Cunapiru to develop 10,000 kw for Rivera and Tacuarembo (3) in the eastern region, a dam on Cebollati River to develop 11,000 kw for Maldonado, Treinta y Tres and other communities.

Chile's principal centers of potential hydroelectric energy, according to the Chilean Development Corp, are in the Aconcagua region to the north of San-

**CHARLES A HOWARD was born in Portland, Maine. After graduating from MIT in 1906 he served as assistant to the chief engineer of Consolidated Edison Co of N. Y., later becoming chief engineer and vice-president of Gunn Richards & Co, New York, consulting engineers. After the first World War he became chief engineer of A B Leach & Co and of P W Chapman & Co, bankers, owners and operators of public utility, industrial and oil properties. Mr Howard was also treasurer and assistant to the president of United States Lines. From 1935 until he entered his present position as technical director of the Inter-American Development Commission, he was with Ford, Bacon & Davis Inc, engineers. Altogether he has spent several years in Europe, Asia and Latin America, doing financial, engineering and development work**

**Typical of Chile's high-head hydro plants is Los Quilos, which adds 20,000 kva in the Santiago region. This plant takes water from two rivers, the Aconcagua and the Colorado. Open canals from the two diversion sites bring water to the forebay, where it drops 720 ft to river level at the plant site. Two double-overhung single-jet pelton wheels drive 10,000-kva 3-phase 60-cycle 6600-v 300-rpm horizontal generators. Equipment was purchased in the United States just before war broke out. Owned and operated by the Sociedad Fabrica de Cemento el Melon, Los Quilos supplies about 10,000 kva the year around to the cement plant at Calera; balance of plant output goes to Cia Chilena de Electricidad for distribution in the Santiago region**

tiago, in the Rancagua region along the Rapel River just to the south of the capital, and in the Orsorno regions, which includes the chain of lakes in the south.

Although Chile's rivers are not large, they plunge down from great heights to the sea and thus offer sites for high-head installations. In addition, some of the lakes are well located for power development. Rainfall exceeds 100 in. per year in some of the southern provinces. Sites for hydroelectric plants have been surveyed at Tocopilla, Copiapo, La Serena, Coquimbo, Sauzal, Ovalle, Lentue, Maule, Leja, Pilmacquen and El Volcan.

### *Power for Cement Making*

Output of the Aconcagua system will go largely to production of Portland cement, as well as providing for railroad electrification and new industries. At present accelerated consumption rates, estimates indicate that Chilean industries will use 600,000 tons of cement per year by 1945, or nearly double 1939's production. Chilean interests have purchased two unused cement plants in the United States which are to be dismantled for shipment and set up in the vicinity of Coquimbo.

Guillermo More, Chief of the Department of Energy and Combustibles of the Chilean Development Corp, describes the work in four zones of activity as follows: *"In the southern zone,* in the vicinity of the Reloncava estuary and Porto Montt, surveys have been made for the 'Ralun' generating plant which will use the waters of Lake Todos los Santos and will produce 50,000 kw of initial power and at least 126,000 in full development. Todos los Santos is one of a chain of beautiful lakes. It is 22 miles long, 500 ft above sea level and only 15 miles from the coast. The nearby and smaller Lake Chapo can produce 39,000 kw at a proposed site known as 'Canutillar.'

*"In the zone of Valdivia-Corral,* the 'Manio' plant on the San Pedro River can produce 50,000 kw with a possible ultimate production of 125,000 kw. A 36-mile transmission line will bring the power to Valdivia and 20 miles more will bring it to Corral.

*"In the zone of Talcahuana-Concepcion-Panco,* the 'Abanico' plant on the River Laja is now under construction with an immediate potential of 40,000 kw and a final capacity of 100,000. A 100-mile transmission line connects with the city of Concepcion. The extraordinary economy achieved in the construction of the plant warrants this unusually long transmission line. This is the most economical of all the plants included in the program.

### *Largest of Its Kind*

*"In the zone of San Antonio,* just south of the city of Santiago, the 'Rapel' plant is to be installed on the Rapel River with an initial capacity of from 60,000 to 120,000 kw. A transmission line of 34 miles will connect with the port of San Antonio. Work has not yet begun on this dam but the plans are far advanced."

The Chilean Development Corp has agreed to allocate the sum of 900 million pesos for construction of this hydroelectric plant on the Rapel River. This, it is said, will be the largest installation of its type in South America, involving

the use of three million cubic meters of water. Part of the power will electrify the state railways. The 30,000-ton-per-yr copper plant which Chile recently purchased from the United States will produce copper wire for this national electrification program.

Bolivia, one of the mountain republics, enjoys large reserves of hydro power. Plants developing some 30,000 kw now supply light to cities and power to mines, but this represents only a fraction of the possibilities. Some authorities estimate that up to 4,000,000 kw could be developed in this republic on the eastern slope of the Andes if the power could be used. Lake Titicaca, it is believed, can be made to produce 700,000 kw, which is more than Boulder Dam now produces.

Colombia now boasts a total of 346 electric plants, of which six belong to the national government or to the departments, 199 to municipalities and 141 to private organizations. Together they produced 293,782,493 kwhr in 1942; consumption of electric power more than tripled from 1933 to 1942.

### *Colombia Plans Expansion*

Colombia is now considering construction of a plant near Manizales in the Department of Caldes, to serve the industries of this region. A 12,000-kw installation is planned for the Paz River between Paicol and Carnicerias, Department of Huila, and another for Florencia in the Caqueta district. Other activities include the completion of a hydro plant at Trumeque, Department of Boyaca, and beginning of work on a station at Titiribi, Department of Antioquia. A recent Colombian law, known as the Economic Plan, authorizes issue of 50 million pesos in internal 4% 30-year bonds to be used in part for nationalization of public utility enterprises now privately owned. Interest and amortization are to be met from income of enterprises nationalized.

Aided by an Export-Import Bank loan, Peru builds a big hydroelectric development at Canon del Pato on the Santa River, which flows into the Pacific just north of Chimbote Bay. Over a year ago, Barton Jones, an electrical engineer previously associated with the Tennessee Valley Authority, initiated work on this project, which includes five generators of 25,000 kw. each. Estimated to cost approximately $4,000,000, the first two units are expected to be completed by the end of 1945. Engineers put the total power potential of the Santa River at more than 5,000,000 kw. Recent discoveries of magnesium in this region and known coal deposits there add incentives for further development.

A new dam at Autisha a few miles east of Lima will increase that city's generating capacity to 91,000 kw. The Peruvian government has approved construction of 11 small hydro plants but lack of equipment retards the work. At the end of 1942 Peru's estimated 225,000-kw electric power capacity compared to 212,000 at the end of 1940. Industrial growth boosted power production 39% since 1939.

Brazil plans to harness the great Sao Francisco River with a series of dams and to exploit the agricultural and mineral resources—iron, gold, mica, bauxite, quartz, diamonds and copper—of this 260,000-sq-mile valley. The Sao Francisco is 1800 miles long and most of it is navigable through the stretches between the falls and rapids indicated below as power sites.

Just below the city of Itaparica and 140 miles from the river mouth, where the great Paulo Affonso Cataracts fall 265 ft, plans call for a hydro plant to develop 600,000 hp. Another falls just above Itaparica is said to be capable of generating 200,000 hp. Higher up the river near Joazeiro stands a third power site, with a fourth much higher up near Pirapora. The American Technical Mission to Brazil has suggested a survey for the development of this river similar to that used in planning the Tennessee Valley program.

Brazil also plans to electrify more of its railroad mileage and work has begun on the 90-mile section of the Sorocabana railroad connecting Sao Paulo and San Antonio. This project will cost over $10,000,000 and take about three years to finish. Owned by the State of Sao Paulo, this double-track line is meter

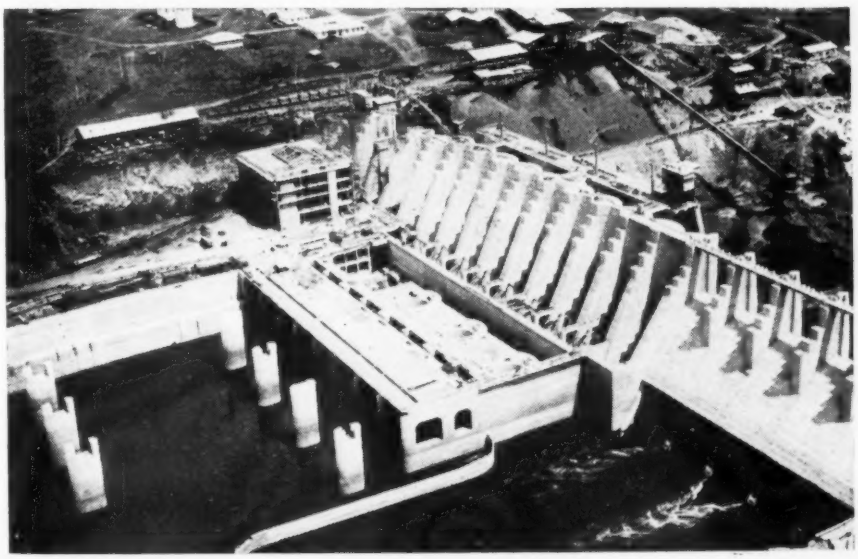
(*Continued on page* 190)

## WHAT TO DO ABOUT PAPER

**Aside from manpower, today's most threatening war shortage problem is paper, urgently needed for battlefield containers and thousands of home-front activities. Further cuts may force reduction in technical magazine articles.**

**POWER readers can help by active participation in all local campaigns to cut paper use, eliminate needless wrappings and make sure that waste paper is saved for salvage collection—not burned.**

**Above all, power engineers in industry can rescue thousands of tons of waste paper sheets and cardboard wrappings from the plant incinerator. Hold everything for salvage.**



**General view of Uruguay's Rio Negro dam after German contractors left the job. U. S. engineers will soon complete first unit (32,000 kw) and transmission lines**

# Small Power Plant Burns Refuse And Pays Out in 1½ Years

***L O Gregg, field engineer, Elliott Co, tells how a wood-pin manufacturer installed his own power plant to burn refuse wood and thus saved on purchased power and waste-wood disposal $19,000 a year—a sum that would be greater today***

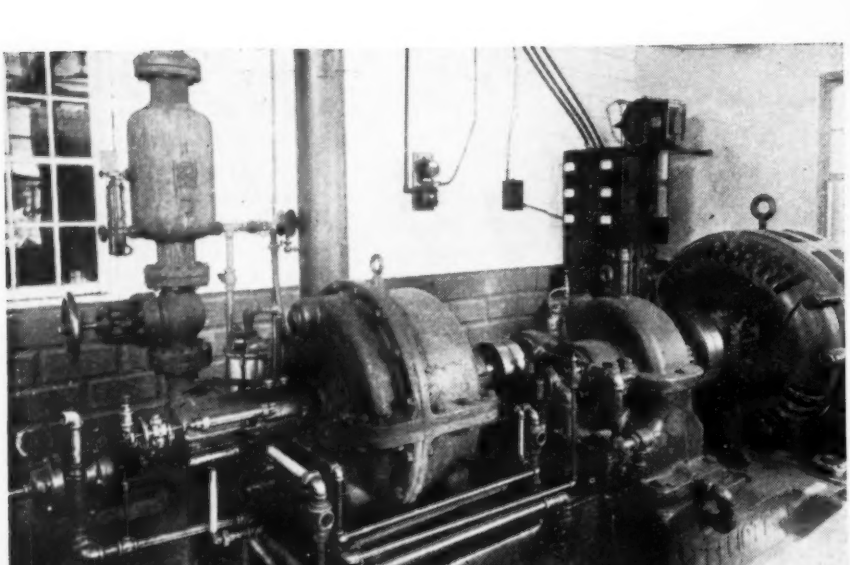


**Fig. 1—This 150-kw geared-turbine generator supplies all electric power manufacturing, operates on 125-psi steam and exhausts at 5-psi for heating**

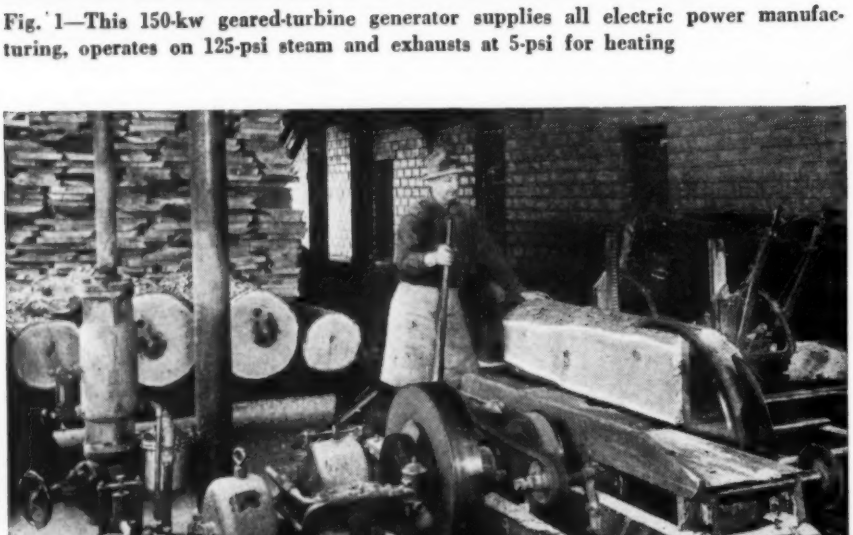


**Fig. 2—A 30-hp steam turbine, with built-in reduction gears connected to a 46-in. circular saw with a flywheel on its shaft, replaces an induction-motor**

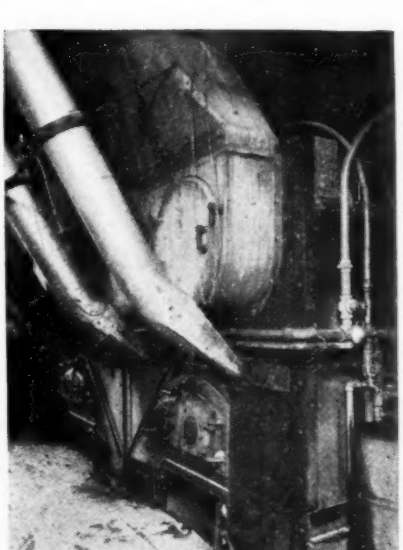


**Fig. 3—Sawdust and refuse wood delivered directly to the furnaces of these two 1300-sq-ft boilers produce all the steam required for power generation and kiln and building heating**

► After the May & Bigley Co, makers of wood insulator pins, moved its plant to Bedford, Pa., all power for manufacturing was generated from waste wood and sawdust. Previously, hauling away and disposing of large quantities of waste from manufacturing about 20 million wood-insulator parts annually was a large item of operating cost. Because of the abundance of this waste as fuel for all power needs, the plant was designed to combine low installation cost with simple and reliable operation.

### *Return-Firetube Boilers*

Two return-firetube Keeler boilers Fig. 3, each with 1300 sq ft of steam-making surface, burn under them the greater part of the sawdust and refuse wood from mill operations. These boilers produce 125-psi saturated steam. City water for makeup feedwater, in combination with condensate from the kilns and heating system, is heated in an Elliott vertical open heater and pumped to the boilers by a centrifugal pump driven by a 3-hp motor.

A 150-kw Elliott noncondensing geared turbine, Fig. 1, exhausting at

5-psi back pressure, drives a 240-v 3-phase 60-cycle generator with direct-connected exciter. This unit supplies a connected load of about 400 hp of motors and lights, operating at approximately 50% load factor.

In 1940, demand for the company's products increased to where power peaks of the plant overloaded the 150-kw turbine generator as much as 50%. These overloads made voltage and frequency of the power system so unstable as to affect production seriously. Chief offender in overloading was a squirrel-cage-motor-driven 46-in. circular saw that cuts locust and oak logs into planks.

Solution of this problem required installing a larger turbine generator to supply all the power load or driving the circular saw with a steam turbine to take this load off the 150-kw unit. The decision favored the latter and a 30-hp Elliott geared-turbine directly connected to the saw shaft, Fig. 2, replaced the induction motor. A 26-in. 550-lb flywheel mounted directly on the saw shaft supplies part of the power during each cut.

### *Flywheel Supplies Power*

It requires about 4 sec to cut through a log, during which time saw speed decreases from 970 to 740 rpm and the flywheel gives up about 22,000 ft-lb of energy, approximately 40 hp for the 4-sec cut. During acceleration and retardation of the saw, turbine and gear operate smoothly. This drive relieves the turbine-generator to where the voltage and frequency are practically constant even with 10% increase in production. Thus, the company not only supplies all power by burning its waste wood, but also heats kilns and factory building with exhaust steam, condensate from which returns to boiler feedwater clean and free of oil.

Total power-generating-plant investment, including that for fuel-handling equipment, was $30,000. Requiring only one man per shift to operate it, and having low maintenance cost, the plant paid for itself in about 1½ years. Before installing the plant three men and three trucks, at a cost of $35 per day, hauled the sawdust and refuse outside the city limits for burning. Total cost of refuse handling and purchased power was about $19,000 per year, of which about $9,000 was for power. These costs would be considerably higher today. Wood ashes from the boilers, rich in potash, are worth $60 a ton as fertilizer, but at present Mr. May uses most of these on his 325-acre farm.

# Refrigerating Engineers Look Toward Postwar Events

▶NEARLY 500 MEMBERS attended the 39th annual meeting of The American Society of Refrigerating Engineers in a 3-day session, Dec 7 to 9, at the Benjamin Franklin Hotel, Philadelphia, Pa.

Highlight of the meeting was the Refrigeration Industry Forum presided over by B C Forbes. The speakers had all been engaged in earnest research on refrigeration possibilities after the war, and were agreed on the industry's bright future. Leading manufacturing executives are cooperating in mapping trends in the refrigeration field. Mr Forbes threw down a challenge by asking why the promise—home air-conditioning equipment within the reach of all—had not been fulfilled.

Many of the papers stressed engineering developments that have resulted from the war. For instance, during the past four years great strides have been made in processing and preserving blood plasma. Experience gained from drying plasma in commercial laboratories and preparing frozen and liquid plasma in Army and Navy laboratories has raised many interesting refrigeration questions. More recently problems concerning refrigeration have arisen in the need for storing and transporting whole blood that must be kept frozen. This requires a compressor unit that is capable of maintaining temperatures of 4 to 6 C in the cabinet when plugged on regular power lines and that can also be operated by a small ½- or ⅓-kw generator. The refrigerator must be sturdy and well insulated so that inside temperature remains constant even in climates where temperatures reach 130 F.

While the principles of refrigeration are the same for marine as for any other service, methods and applications were cited as being quite different by F W Hutchinson, University of California, in a paper, "Refrigerating Design Problems In Marine Installations."

Mr Hutchinson pointed out that problems associated with marine cold-storage plants generally have special or peculiar operating limitations that require unusual treatment. Premium on space which characterizes all ocean shipping frequently reflects in improper loading of freezer boxes and cold-storage compartments. Commonest difficulty arises from stowage of cargo too close to, or directly against, the cold-air discharge with the possibility that controls will shut off cooling before cargo has reached carrying temperature.

A B Stickney, Chicago, president

Specialized marine problems arise from running refrigerant lines to and from the condensing unit through a wide variety of spaces en route to the cold-storage area. Under such conditions the liquid may reheat after it leaves the condenser and passes through an engine room. An opposite condition occurs when the liquid line passes through lower temperature areas on its way to the evaporator. Here sub-cooling produces increased refrigerating effect at the expense of greater load on lower temperature units and increases power requirements of the system as a whole.

In "Trends in the Refrigeration of Foods," Gerald A Fitzgerald pointed out that it was time to turn attention to refrigerating foods in the field. Field cooling prevents wilting and therefore furnishes a more marketable product.

Mr Fitzgerald also pointed out the advisability of installing freezing equipment in fishing craft. Science has proved that freezing inhibits all deterioration, but holding perishables in ice at 32 F does not. The fish would no longer have to be gutted at sea but could be

(*Continued on page* 140)

# Electrical Power Distribution Systems Planned to Load Requirements

***R H Kaufmann, industrial engineering division, General Electric Co, presents fundamentals of electrical-power distribution system design, outlines a simple 5-step procedure for planning such systems and compares their relative costs and copper weights***

▶ WHETHER IN WAR OR IN PEACE, a plant's power distribution system is one of the most important elements in modern mass production. Failure of electric power may cause a complete shutdown of all manufacturing facilities. So vital a function as that performed by the electrical system demands care in design, installation and operation. Even though it involves integration of many elements, electrical-distribution planning becomes quite simple if a few fundamentals are applied.

First, let us consider the qualities that distinguish a good distribution system from a poor one and what qualities the designer should embody in such a system. In my opinion, their order of importance is: (a) insured power to production machinery at all times (b) conservative use of material, particularly copper (c) safety for equipment and personnel (d) minimum service interruption from malicious interference (e) equipment simple to install, operate and maintain.

With these objectives, we can develop a plan to include the following five steps:

1. *Choose ideal unit-load-area size*
2. *Determine probable total plant load*
3. *Divide total plant load into economical unit load areas*
4. *Select suitable distribution-system form*
5. *Detail the distribution circuits*

*1. Choose ideal unit-load-area size:* Total electrical load usually includes many small items, such as motors, lights and heating units that operate on 110, 220 or 440 v. To transmit power at these voltages over relatively long distances requires large amounts of copper at correspondingly high cost, as shown in Fig. 3. About 40 times as much copper and 20 times the capital investment are required to transmit a given amount of electric power at 440 v as at 13.2 kv.

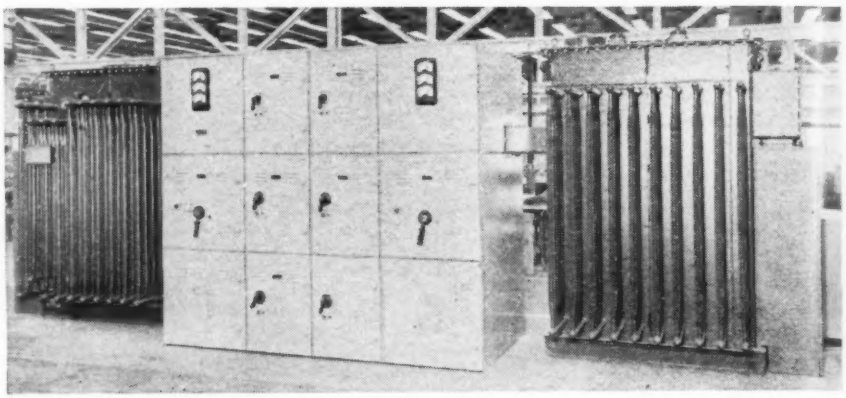


**Fig. 1—1200-kva load-center substation, consisting of two 600-kva self-cooled transformers and two main and six distribution-feeder breakers**

To transmit this power at 220 v requires at least twice the copper and capital investment as at 440 v.

This emphasizes two important fundamentals of distribution-system design: (1) transmitting power as far as possible at highest practical voltage (2) using 440-v equipment in preference to 220-v wherever feasible.

To transform from high to low voltage at each machine is generally impracticable because of the larger amounts of materials and capital investment required for a great number of small units. Then the question arises: How large an area can be served economically from a given transformer center?

Fig. 5 shows load areas surrounding a transformer center. The low-tension feeders for each successive load zone become longer and require correspondingly more copper and capital investment per kva delivered.

Fig. 4 tabulates total load in each load zone of Fig. 5, at 10 va per sq ft together with approximate mean length of horizontal feeder runs, weight of copper and installed low-tension-feeder cost per kva of load in each zone, based on 440-v utilization potential. This indicates the principal factor tending to restrict unit-load-area size. For example, it requires over six times as much copper and costs nearly eight times as much to install per kva in the outer zone with an average feeder length of 263 ft as in the inner zone with an average feeder length of 50 ft.

Fig. 3 and 4, however, do not tell the whole story because other factors operate in the opposite direction. As transformer size diminishes, the amount of material in them and their installed cost per kva increases. Primary switching and cable-terminal facilities are more or less a fixed item for each station, which increases the cost per kva as the size of the station decreases. Cost of low-tension switching equipment per kva tends to increase for station capacities above 750 kva at 480 v.

### *Comparison of Costs*

Based on 13.2-kv high-tension feeder, 480 v at the load center and 440 v at individual loads, Fig. 6, shows copper cost and total installation cost per kva for equipment to serve different capacity load centers. Costs include the load-center substation with its primary switching devices, transformer, low-tension switching equipment and feeders. The curves show that the most economical size of 480-v load center is between 500 and 1000 kva. Most eco-

nomical size of load centers for 220- or 208-v distribution equipment is about one half that for 440 v, or 330 to 500 kva.

*2. Determine probable total plant load:* There are many ways to determine approximate total load. Some methods add up individual connected loads and multiply this sum by a factor that includes the demand, load and diversity factors. In general, the factor for machine-tool areas ranges from 0.05 to 0.5, common values being 0.15 to 0.33. Some engineers use a rule-of-thumb method, based on experience with similar plants.

The motor rating used with each individual machine drive must be matched with its maximum service duty, which may exist for only a small part of the total operating time. Many operations are intermittent resulting in the drive motor being lightly loaded during a large part of the operating time. Between the completion of machining operations on one piece and the beginning on the next, load usually is low. When a group of machines are operating, these conditions result in a total load much less than the sum of connected loads. In contrast with this are practically constant loads, such as boiler-feed pumps, conveyors, and electrochemical-process operations, in which actual load may approach closely the sum of the individual loads. Electrical-load requirements for these applications usually may be evaluated separately and added to the value required for the less-constant loads.

Experience indicates that electrical loads in machine-tool areas fall quite consistently within a relatively narrow range when the load is expressed in volt-amperes per sq ft. Typical values are for fluorescent light, 2 to 3 va per sq ft; incandescent lighting, 5 to 6 va per sq ft; power for assembly areas, 5 va per sq ft or less; precision-machining areas, 4 to 8 va per sq ft, and coarse machining areas 8 to 15 va per sq ft.

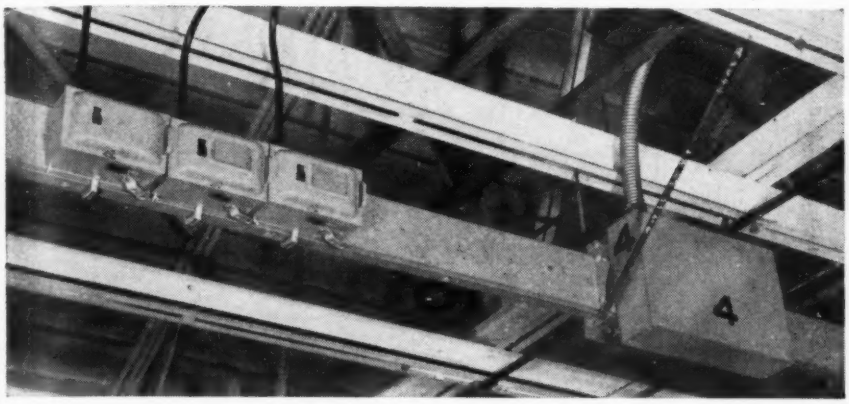
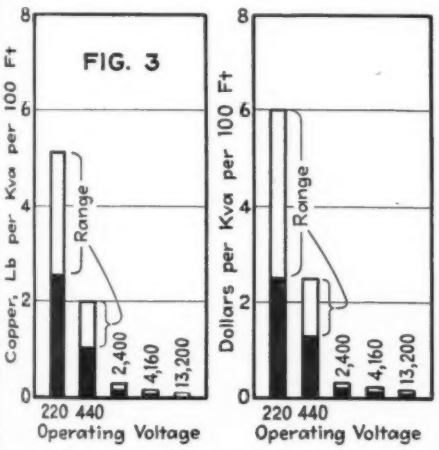


Fig. 2—Power is frequently distributed by an inclosed bus like this one that permits taking branch circuits from it at any location along its length

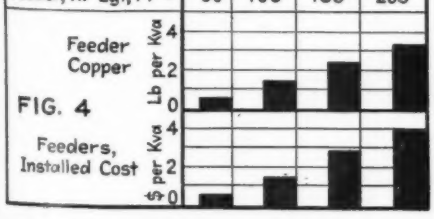
### *Concentrated Loads*

Concentrated groups of machines—such as refrigerating compressors, water-circulating pumps, blowers, and banks of heating furnaces—all require individual consideration when evaluat-




| Zones → | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Load, Kva at 10 VA per Sq Ft → | 100 | 300 | 500 | 700 |
| Feeder, Av Lgt, Ft → | 50 | 106 | 188 | 263 |

FIG. 4



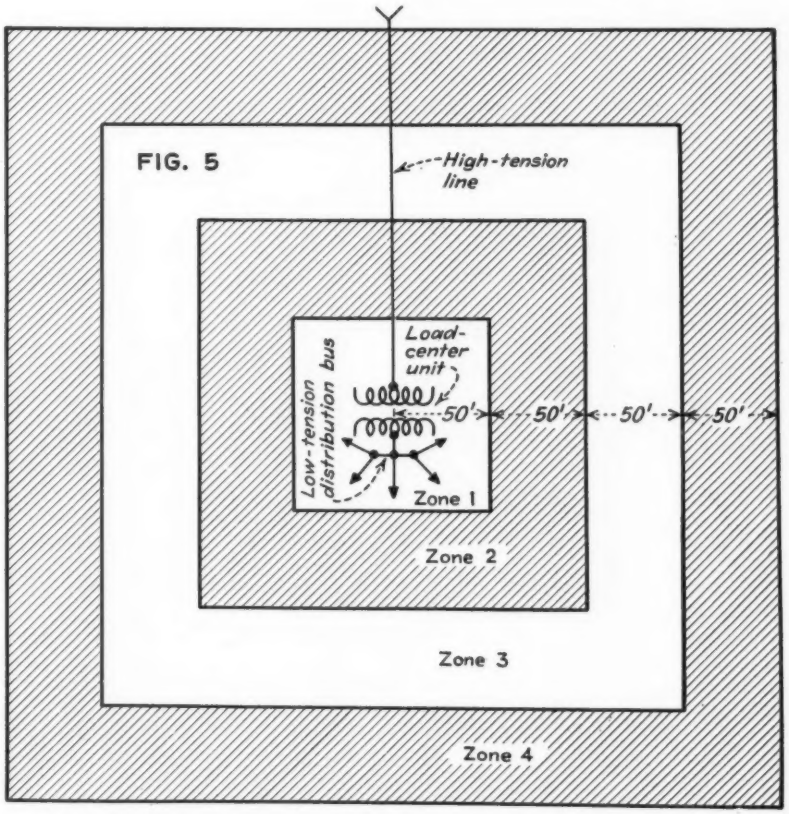




Fig. 3—Weight of copper and its cost to transmit one kva 100 ft at different voltages. Fig. 4—Total load in each load zone, Fig. 5, at 10 va per sq ft together with mean length of horizontal feeder runs, weight of copper and installed low-tension-feeder costs per kva of load in each zone, based on 480-v distribution potential. Fig. 5—As the load area surrounding a load center grows larger the power feeders get longer, heavier and more costly.

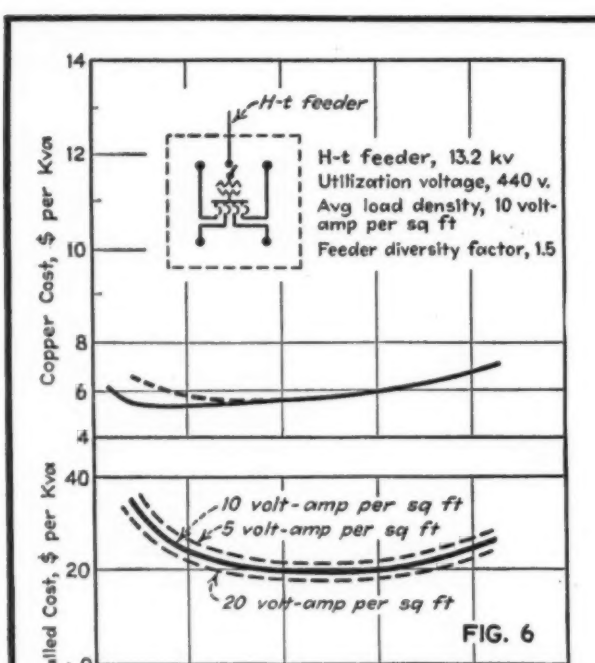



FIG. 6

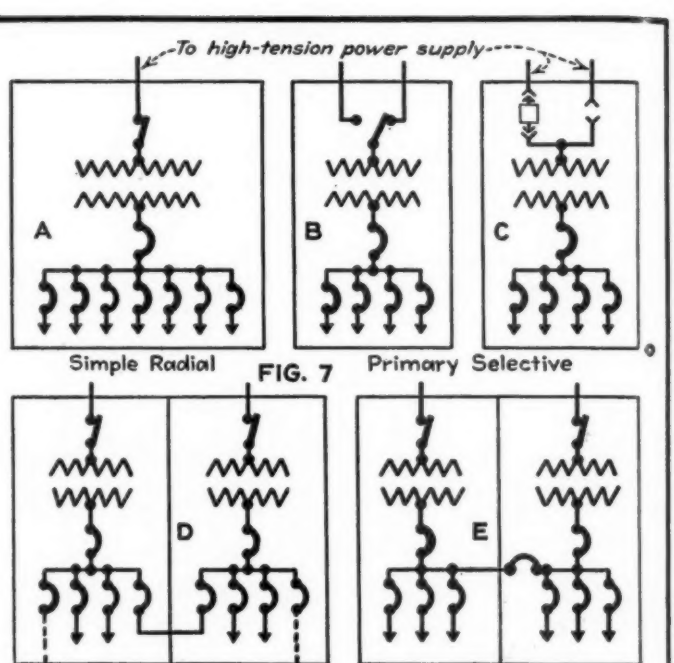



FIG. 7

**Fig. 6—Copper and installed costs for different-sized load-center units, based on 13.2-kv high-tension feeder, 480 v at the load center, 440 v at individual loads and 10 va per sq ft of load area. Fig. 7—Diagrammatic arrangements of the simple-radial primary-selective secondary-network and secondary-selective systems of power distribution**

ing total plant load. Such concentrated loads may produce local load densities considerably greater than the figures given.

To illustrate how to determine total load, assume a machine-shop area with a working floor space 600x1200 ft where small parts are to be machined to close tolerances. Fluorescent lighting is used. If in this 720,000 sq ft of working area we allow 2.5 va per sq ft for lighting and 6 for power, total plant load equals $720{,}000 \times 8.5 \div 1000 = 6100$ kva. Appropriate load-center units for this area would consist of six 1000 or eight 750-kva units.

*3. Divide total plant load into economical unit load areas:* To subdivide total load area draw imaginary boundaries around areas containing a load block corresponding to the load-center rating selected. Individual load areas need not be symmetrical nor of the same physical size, and they need not be exactly defined until equipment installation is in progress. This is particularly true of a distribution system using load-center unit substations and moderate-capacity low-tension feeder circuits. With such equipment, the distribution system becomes as flexible and mobile as any of the machine tools in the working area. Future changes to meet a rearrangement of machine tools are accomplished easily.

As previously shown, the ideal location for a load-center unit is at the center of its respective load area. Small variations from this ideal location will not materially affect over-all results, so the load-center unit substation can use space not essential to other services.

*4. Select suitable distribution-system form:* This is a problem of providing adequate operating flexibility without accepting serious sacrifice in other characteristics, such as invested material, simplicity of operation, safety or installed cost. A brief resumé of the evolution of basic distribution systems helps clarify this problem. Fig. 7 shows the characteristic makeup of several load-center arrangements. Total plant load probably requires several load centers fed by a multiplicity of primary feeders. As a rule each primary feeder picks up several stations.

A simple radial system, Fig. 7*A*, is characterized by a single direct elec-

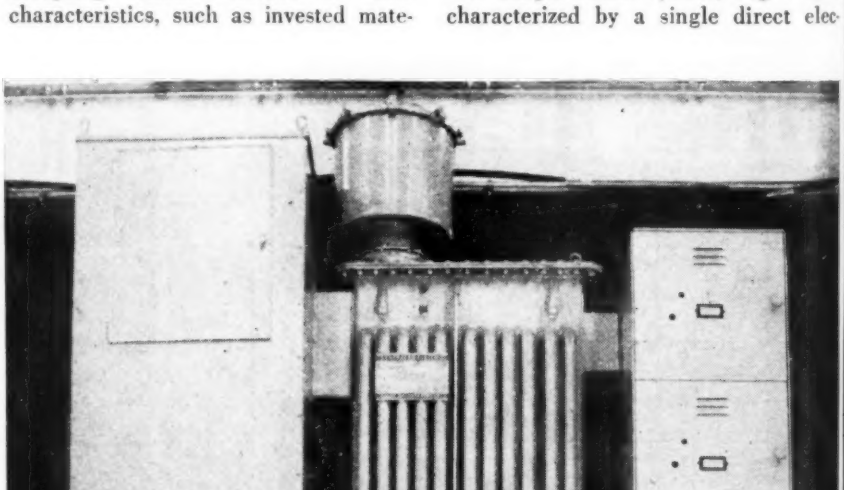


**Fig. 10—Load-center unit substations may be of small size like this 100-kva one, located in an industrial plant to supply power to fluorescent lamps**

trical circuit from the primary high-tension supply to each load center. It conserves material, is easy to install and operate, rates high in safety, and has lowest installed cost.

A primary selective system, Fig. 7*B* and *C*, may be considered as a direct development from the simple radial system. A transfer switch on the high-tension side of the transformer permits connecting to either of two primary feeders. A 2-position metal-clad structure in combination with either one or two removable circuit-breaker units is a common means of incorporating this function. To balance safety and first cost, the transfer switch often has only sufficient capacity to open safely the transformer magnetizing currents and occasionally has no circuit-interrupting rating, all switching being done by the main-power circuit breaker. The next step in extending distribution-system operating flexibility connects two or more sources of low-voltage power at their distribution bus. Both secondary network and secondary-selective arrangements do this, Fig. 7*D* and *E*.

### *Secondary Network System*

Continuous parallel operation of several alternate sources of low-tension-power supply produces what is known as the secondary-network system. It can maintain uninterrupted service when a failure occurs in any low-voltage circuit or when one of the primary feeders goes out, if provided with suitable selective circuit-interrupting equipment. Low-tension bus short-circuit currents generally will be higher with this system, making necessary circuit breakers of greater interrupting ability.

In the secondary-selective system two load-center units are merged together as a single unit, Fig. 7*E*. A tie between the two low-voltage buses is normally open so that each system operates independent of the other. In emergencies, the tie switch can be closed and power supplied from one high-tension feeder to both low-voltage systems. This arrangement retains the desirable features of the simple radial system, yet it provides each low-voltage bus with two independent power sources.

### *Weight of Copper*

Fig. 8 presents a comparison of copper weight per kva required for the distribution systems, Fig. 7*A* to 7*E*, as a function of unit size supplying different-sized loads. This shows that the amount of copper for the secondary-selective system is only about 9% more than that for the simple-radial or the primary-selective system. For a 750-kva load-center unit, secondary-selective-system copper is about 20% less than for the secondary network. Fig. 9 gives a comparison of relative installed costs of the different distribution systems using 750-kva load-center units. These figures are based on 13.2-kv primary feeders of 1000 ft total length; 10 va per sq ft load density; 440-v low-tension load; 1.5 low-tension feeder diversity factor; and no reserve transformer capacity. For these conditions the secondary-selective system costs only about 18% more than the simple-radial system.

These comparisons assume that load restrictions exist during emergency operation and that all equipment operates at near rated capacity under normal conditions. Of these systems, the secondary-selective provides a high order of reliability at only a small increase in copper and installed cost over that of the simple-radial system.

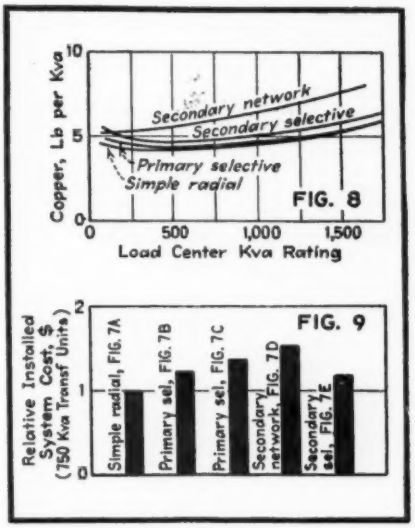



**Fig. 8—Weight of transformer and low-tension-circuit copper for load-center units connected to distribution systems. Fig. 9—Installed cost of a 13.2-kv to 480-v 750-kva load-center substation connected to different distribution systems**

*5. Detail the distribution circuits:* When distributing power from load-center units, low-tension feeders radiate to sub-distribution points or to large machines such as compressors, fire pumps, rectifiers and similar equipment. This distribution is frequently made from a power plug-in bus, Fig. 2, along which the circuits are taken off directly to individual loads or to panels that serve several small circuits.

Lighting distribution centers include branch-circuit switches and frequently 15- to 75-kva air-cooled transformers that supply 120-v lighting circuits. For large installations, direct operation of fluorescent lights from 3-phase 4-wire 480-v distribution circuit saves material and reduces installation cost. Fluorescent units rated 275 v are connected from the neutral to the phase wires.

Individual feeder circuit of 200- to 400-amp capacity are generally the most satisfactory. Low-tension 3-conductor cable feeders of 250,000 to 500,000 cm provide a simple, flexible means of transmitting power to sub-distribution centers and have been standardized on a number of jobs. Use of smaller sized feeders increases low-tension switching costs because of the larger number of switches required. On the other hand, individual feeders of greater capacity reduce effective use of copper in the conductors because of skin and proximity effects.

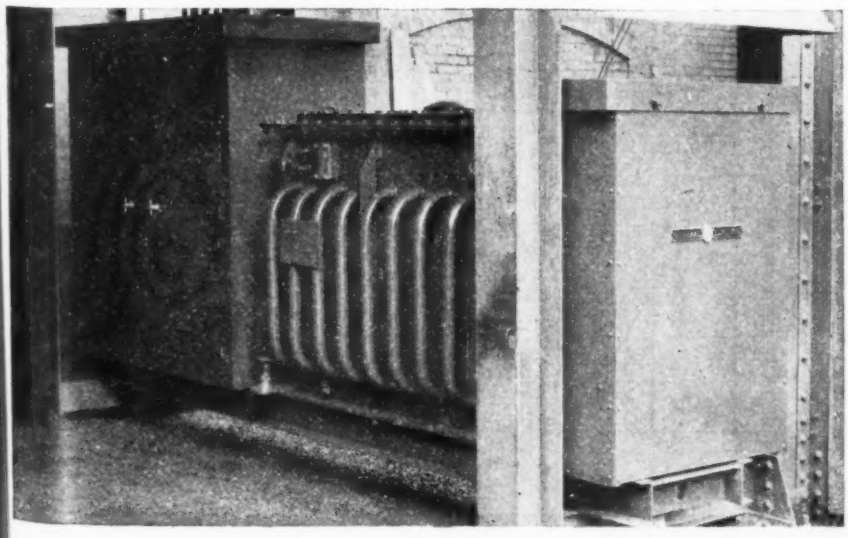
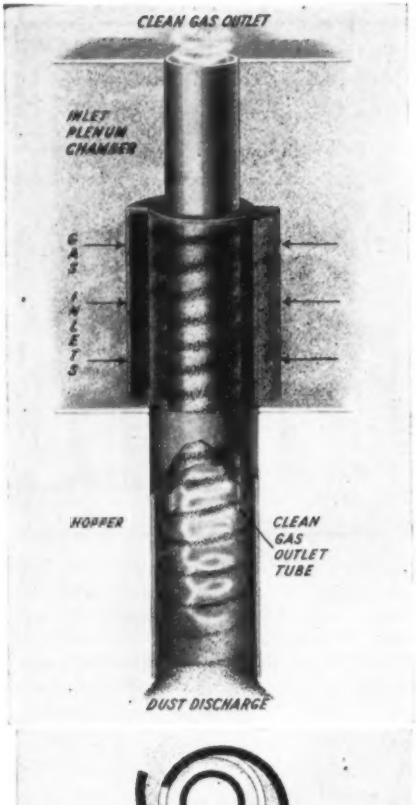
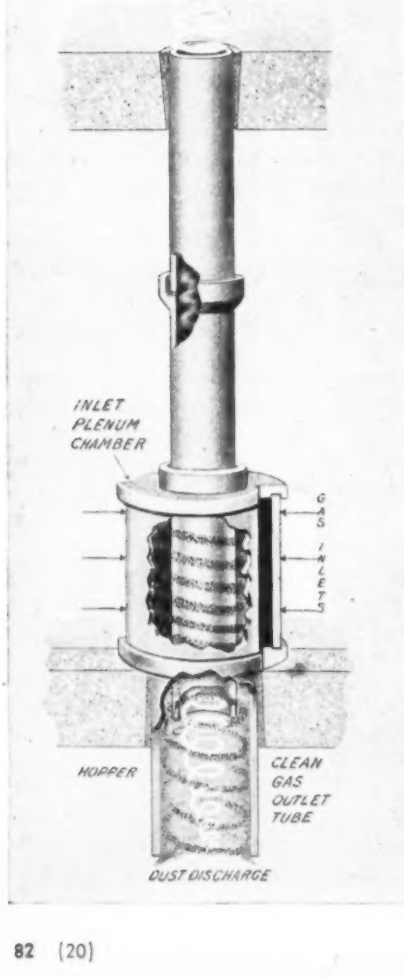


**Fig. 11—Small load-center unit substations may be placed outdoors as in this compact installation with the transformer in the center rated 150 kva**






# Ceramic Dust Collectors Beat W

***Whether the problem is reclaiming industrial waste or taking solids out of flue gas.***

► APPARATUS FOR DUST COLLECTION is essential in many industrial operations and has become an integral part of modern power plants. Practically all such equipment, however, is built of steel and to economize on this critical material, internal parts of flue-gas cleaners have been omitted from many boiler installations even in war plants where abrasive ash particles from stacks were known to interfere with close-fit assembly of running parts.

From the very start of an investigation into building dust collectors of non-critical material, it was evident that the approach should be based on ceramic materials since the supply of raw product is unlimited. But apparatus, such as would be used in conjunction with a collector fan, or cyclones of two feet or more in diameter, has large individual parts, judged commercially impractical by ceramic manufacturers.

Tubular collectors of relatively small diameter require only pipes and tiles similar to those commonly produced by ceramic manufacturers, and lend themselves to assembly with a minimum of joints. Also, a very minimum special machinery has been required for their production on a quantity basis.

Fig. 1 shows the design of one element of a tubular collector of steel. The main 6⅝-in. tube incloses a 4½-in. outlet tube. Inlets of heavy steel plate are welded to an upper and lower disk. Each tube handles up to 300 cfm of gas

**Fig. 1—(above)—In its original steel construction, this collector takes in flue gas through vertical slots and exhausts through a central tube**

**Fig. 2—(Left, below)—Assembly of ceramic fittings cemented together between steel or concrete tube sheets**

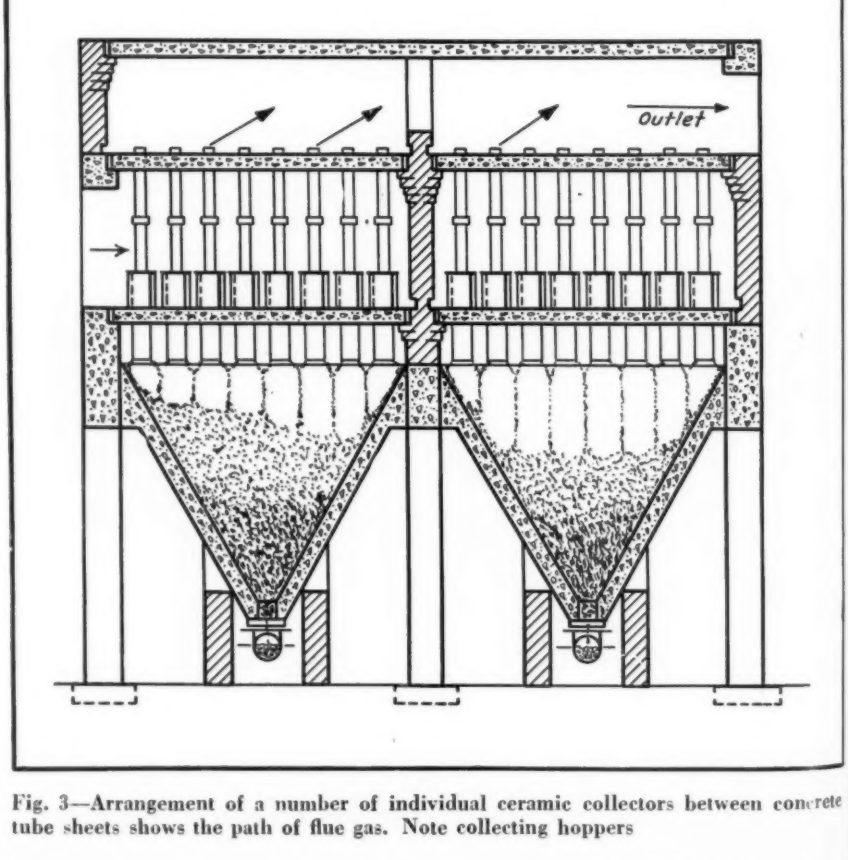



**Fig. 3—Arrangement of a number of individual ceramic collectors between concrete tube sheets shows the path of flue gas. Note collecting hoppers**

# Wartime Steel Shortage

## *it can be done without critical materials*

*says* ***Louis C Whiton, Prat-Daniel Corp****

and any number are arranged between tube sheets to handle required flow.

The ceramic tube, Fig. 2, consists of a 6½-in. tile with a flanged top in which have been impressed recesses for holding the "wings" or flared inlets to the tube. The wings are heavy curved tile, capped with a companion flange identical with the flange of the lower tube. The central 4½-in. tube resembles standard clay tiles and may be extended upward by additional tubes.

A special cement has been developed by the tile manufacturer, composed of practically the same material as the tubes. When the parts are joined in a jig, a chemical reaction in the cement starts in about 25 minutes and within a reasonable time thereafter the tube assembly can be readily handled without failure of the joints. Normally they are allowed to set for a 24-hr period.

At first these tube elements were set between steel tube sheets, into which they were cemented with the same ceramic material as made up the tile-to-tile joints. The outlet tube, of course, was arranged with a slip joint to allow for expansion.

Later developments required elimination of steel tube sheets and a satisfactory substitute was found in reinforced concrete. While the behavior of concrete is not so well known as that of steel under high flue-gas temperatures and fluctuation of temperature, several installations of reinforced-concrete flue ducts were checked and found to have operated satisfactorily for periods of 20 years or more. But it has been learned that composition and mixing of the concrete must be carefully controlled.

Space requirements of ceramic collectors are greater than for steel tubular collectors because tiles are thicker than the steel tubes and the exterior concrete walls require greater thickness. A typical arrangement of the assembly is shown in Fig. 3.

The double-deck arrangement of Fig. 4 saves considerably in floor space over Fig. 3, but, of course, at the expense of greater height. The structure may serve as support for the induced-draft fan or may be adapted as part of a structure for coal hoppers.

The ceramic tube weighs approximately the same as the steel tube it replaces. By the addition of reinforced concrete tube sheets, the entire weight of a completed unit is, of course, greater than for steel construction.

Careful studies have been made, but no difference in the efficiencies of the ceramic apparatus as compared to steel has been observed.

In addition, ceramic construction offers important possibilities for use after the war in connection with handling hot or corrosive gas for which steel dust collectors would be unsuitable.

*Condensed from a paper presented before the Metropolitan Section of the American Society of Mechanical Engineers

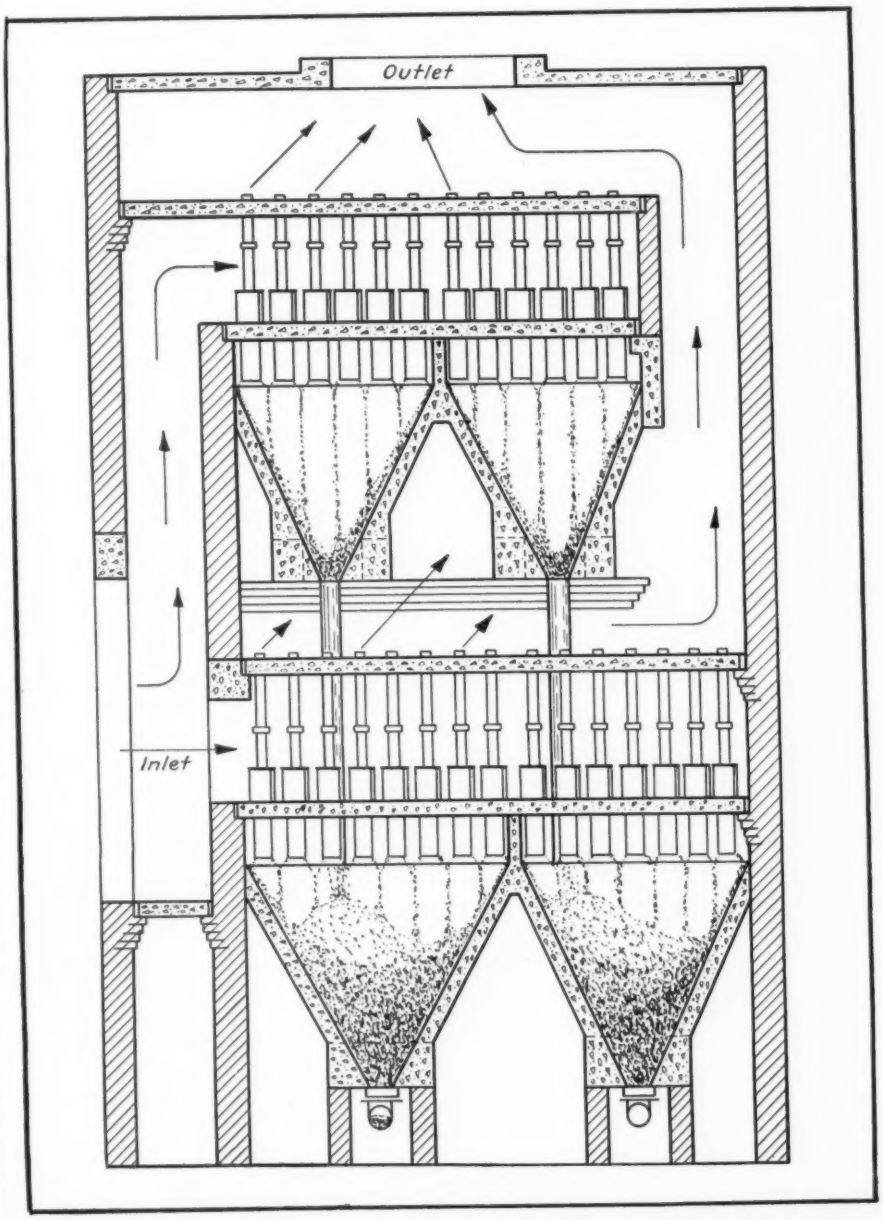



**Fig. 4—Double-deck installation saves considerably in floor space over Fig. 3 and may be built into supporting structure for the induced-draft fan**

### Our Error

**Pacific Southwest Power Interchange Committee chairman was incorrectly designated on page 99, December POWER—Mr. N B Hinson, Southern California Edison Co, Ltd, is present chairman of the Committee.**

# WHAT'S MYSTERIOUS ABOU

***Nothing, says A F Schwendner, Westinghouse Electric & Mfg Co. Analyze turbine-control fundamentals one at a time and you learn that a governor's action befuddles the onlooker only when the mechanism is considered as a complete unit***

▶ NORMALLY A GOVERNOR has two main functions: The first is to respond to minute changes in speed. The speedometer is a governor that performs only this office. The second function is to transform changes in speed into proportionate steam flow, thus restraining the machine against overspeeding and preventing its stalling under load.

Fortunately, these two jobs have a common denominator: both depend upon speed or changes in speed. Here, then, is the governor's most fundamental characteristic. It must be sensitive to speed changes, and must have some means of indicating them. This brings up its second duty. The speed-change indication must operate a valve or other control mechanism so that energy input to the turbine is readjusted to compensate exactly for a change in speed.

### *Simple Governor*

Remember the flyball governor on grandpa's threshing machine? That is probably the first and simplest practical steam governor, and for many modern turbine applications it is still adequate. It consists basically, Fig. 1, of two metal spheres connected by straps to two collars on a shaft that is driven by the turbine. One collar, *A*, is fixed solidly to the shaft, the other, *B*, is free to slide up and down. Between them is a spring, tending to keep them apart. If the turbine gains speed, the flyballs move outward under centrifugal force and pull the movable collar, *B*, against the spring. Hence, change in speed has been translated into straight-line movement of the collar along the governor shaft. Connecting the collar through a mechanical linkage transmits this movement to a governing valve, that changes steam input in proportion to speed change.

This flyball governor has the one unparalleled virtue of simplicity. But it is also a weakling, a laggard and, on occasion, a liar.

It is a weakling because the only energy it can contribute to move a valve is produced by the difference between the centrifugal force of the weights and the opposing spring force. Disregarding friction, the governor collar has a definite position for each speed and in each of these positions centrifugal force of the weights and spring force balance each other.

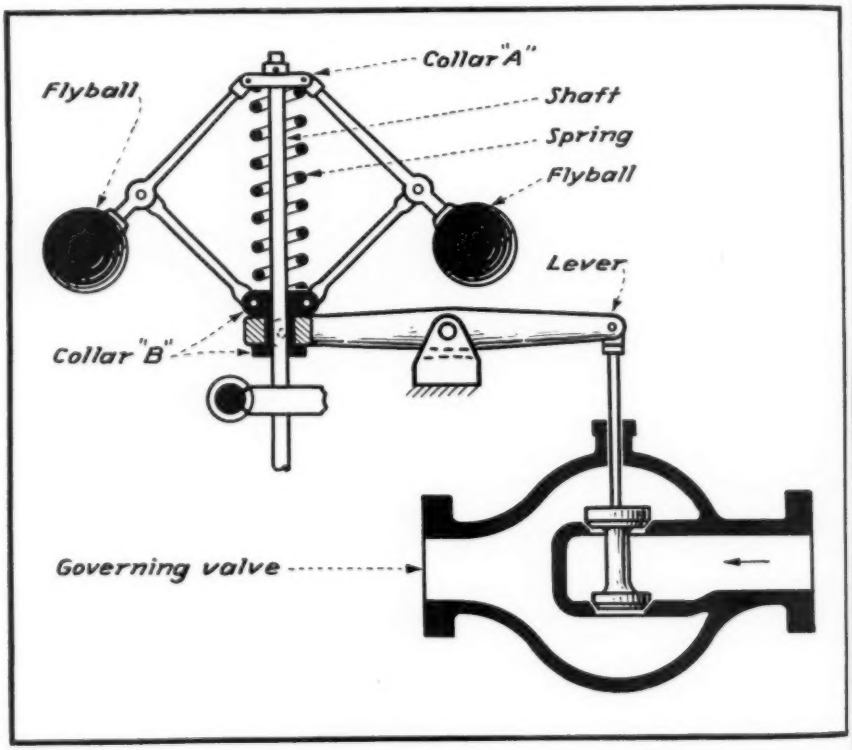
It is a laggard because it must lag behind its true position enough to build up sufficient force to overcome spring opposition and friction resistance.

As a result of lag, it becomes a liar because it is seldom in true travel position as determined by speed and, besides, its travel in line with a set speed change may vary at different points of the governor position. The spring, Fig. 2, is calibrated and we know its force for every length of compression. Let's rotate the governor at constant speed—2% below normal—and change the spring compression to obtain a weight movement for each compression point. We can then lay out a curve showing the corresponding spring forces for each governor position at 98% speed. In like manner, we obtain the 99, 100, 101 and 102% speed centrifugal-force curves, Fig. 2. Curve shape depends on governor design and may deviate considerably from a straight line because of link and radius distortion. But for our purpose we assume they are straight lines converging toward the center of rotation, or zero centrifugal force.

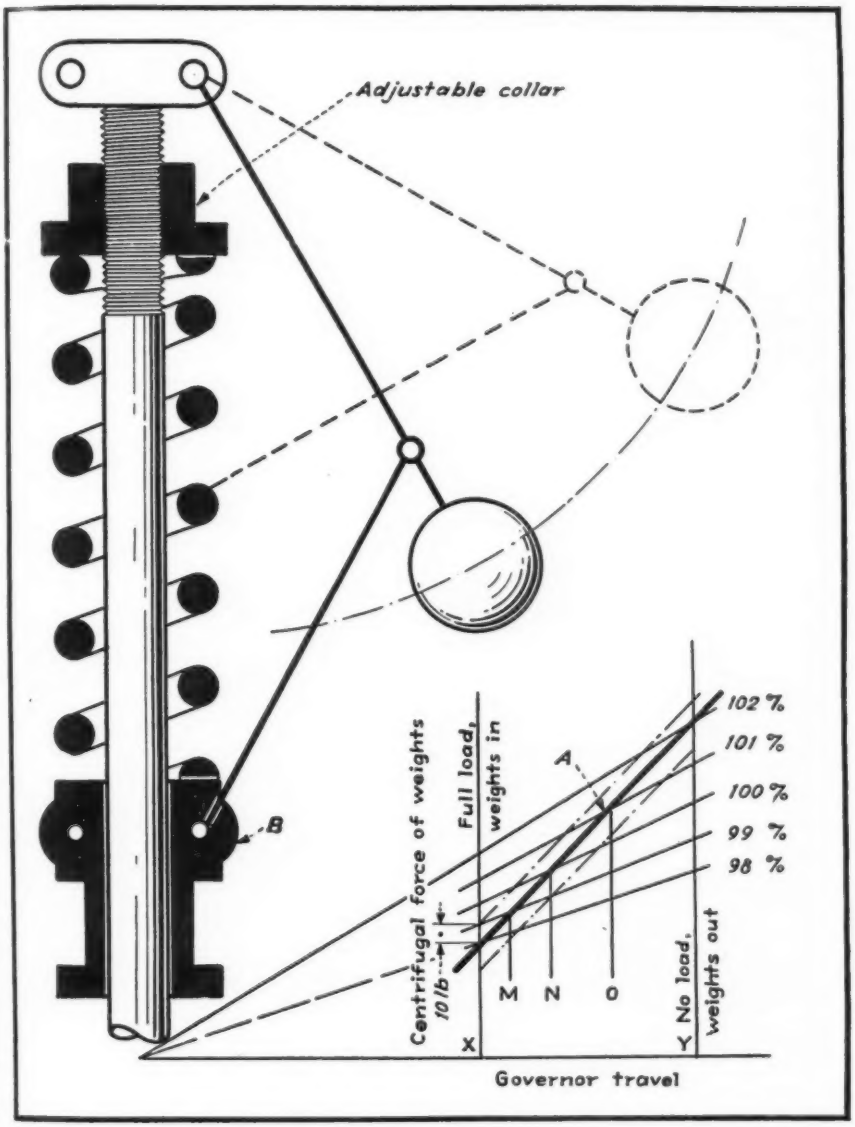
The two vertical lines, *X* and *Y*, enclose that part of the governor travel needed to give full travel to governor valve. Right-hand line *Y*, or the weights-out position of the governor, indicates governor valve in no-load position. Left-hand line *X*, or the weights-in position of the governor, indicates the governor valve at its rated load position. We now need a spring with a compression equal to the force shown at the intersection of line *X* with the 98% speed line and that also matches the force shown at intersection of line *Y*, with the 102% speed line at the corresponding travel or spring compression.

**Fig. 1 (below)—Flyballs linked solidly to steam valve must take a position corresponding to correct valve opening for every load from zero to full load**

**Fig. 2 (right)—Rotate governor at constant speed and change compression of a calibrated spring to obtain weight movement for each point along speed curve**



# A GOVERNOR'S ACTION




With this spring in place the governor will open the governor valves far enough to carry rated-load at 98% speed, and will close them enough to hold 102% speed without load. Unit speed change from no load to rated load is 4% and is called the governor speed regulation. It is obvious from the curve that if a higher or lower governor speed regulation is required the governor spring must match the different centrifugal forces of the weights at the different speed lines. If, for instance, a 3% speed regulation is required, we will have the same centrifugal force at 98% speed with valves open, but the centrifugal force at 101% speed will be less than we had at 102% speed. The governor travel will be the same because steam flow and valve travel required do not change. The governor spring force must then be made less for the same amount of compression. On the other hand, if a higher regulation is required, the governor spring force must be increased for the same compression. Amount of change depends on the centrifugal force change from the original to the new value.

### *Speed Affects Travel*

Curves in Fig. 2 show the governor travel for each 1% speed change, at the point where the spring-force line *A* crosses the speed lines, provided the governor sleeve is absolutely frictionless. Suppose the governor weights and linkage are so proportioned that the centrifugal force change, for 98 to 99% speed change, is 10 lb at governor collar *B* when it is in rated-load weights-in position, or line *X*.

Suppose we restrain the collar *B* by adding friction so that 10-lb force, over and above spring opposition, is required to move it from any position. Governor is now running at 98% speed with full load and if we remove load from the unit its speed starts to increase. However, collar *B* will not move until the speed increases to 99% and the governor force increases above that of the opposing spring by 10 lb.

The change in governor force for 1% speed change without motion is the governor's power at that particular position. This particular governor has a power of 10 lb in rated-load position.

Suppose we further unload the unit and check governor position in relation to its speed. We find it gives us a line parallel with *A* but the 10-lb power of the governor will be obtained with less and less speed change as the weights travel outward. It is obvious that when we talk about the power of a governor we have to mention weight position. In the no-load position, line *Y*, about ⅔ of 1% change produces the 10-lb necessary to overcome governor-collar friction, or we now have about 15-lb governor power for 1% speed change.

### *Collar Friction*

The governor is now in the no-load position and at the 102⅔% speed point because of the 10-lb friction on collar *B*. Suppose we slowly load the unit again. First the speed drops to 102% but this change will not start the governor collar moving because force in spring and weights now balance, so the speed must drop another ⅔ of 1%.

From here on the sleeve will move as speed decreases, drawing another line parallel to, but now 10 lb below line *A*. This continues until governor reaches rated-load position at a speed 1% lower than the original 98%. Vertical distance between parallel lines above and below line *A* represents the governor's dead band; the speed change in which no governor motion occurs. Since the same amount of friction gives one value of speed at one governor position and a different one at another, the dead band must also be considered in relation to the governor position.

Suppose we measure governor travel for each 1% speed change or the distances between points where the speed lines cross line *A*. We find that the governor travel between 101 and 102% speed is almost three times that between

the 98 and 99% points, vertical lines *M*, *N* and *O*. By changing the design of a governor, this characteristic may be reduced but seldom eliminated.

So far we have considered only characteristics of governors that have no means of changing speed while in operation. When the governor must regulate a turbine that drives an ac generator, the normal speed of the unit has to be maintained regardless of the load carried. So we need a speed changer that can alter the turbine speed while unit operates. This can be accomplished in various ways, each one affecting the governor performance in a different manner. One of the methods used changes the spring compression.

### *Speed Changer's Job*

Let's look at Fig. 3A. Since the speed changer is not an automatic device, a load change causes a speed change first, which is corrected later. Suppose we start a unit fitted with a governor set to have 102% speed at no load. We bring its speed down to normal by moving the speed changer to decrease the governor-spring compression.

Line *a* then moves down, parallel to its original position, until the point, which originally crossed the no-load 102% speed point, now crosses the 100% point, dotted line $a_2$. If we now add load, the governor valve position and corresponding decreasing speed follows line $a_2$. To hold normal speed, we reset the speed changer for every load change up to rated-load. The speed changer has now moved the governor spring to a position indicated by line $a_1$.

Well, there's nothing wrong here; we only changed the governor-spring compression to maintain normal speed through a complete load change. Let's look at that curve a little closer. We are now in spring-compression position $a_1$. Suppose we unload the unit without adjusting the speed changer. Governor position and speed follow line $a_1$, but when $a_1$ crosses the no-load line the turbine speed has increased only 3%. What happened to our 4% governor? Now go back to our first position when we started to add load. With the governor-spring compression in position $a_2$, suppose we load the unit without adjusting the speed changer. Governor position and speed then follow line $a_2$ but it crosses the rated-load line 7% below normal speed. We now have a governor that has 4%, then 3%, then again 7% regulation.

We cannot move a line, *a*, crossing converging lines without showing differences between the wide and narrow parts between the speed lines. Fig 3B is a governor speed-regulation curve that shows change in governor regulation with different speed-changer positions. It is easily obtained from curve 3A. Plot percent of governor regulation on horizontal line, and change in

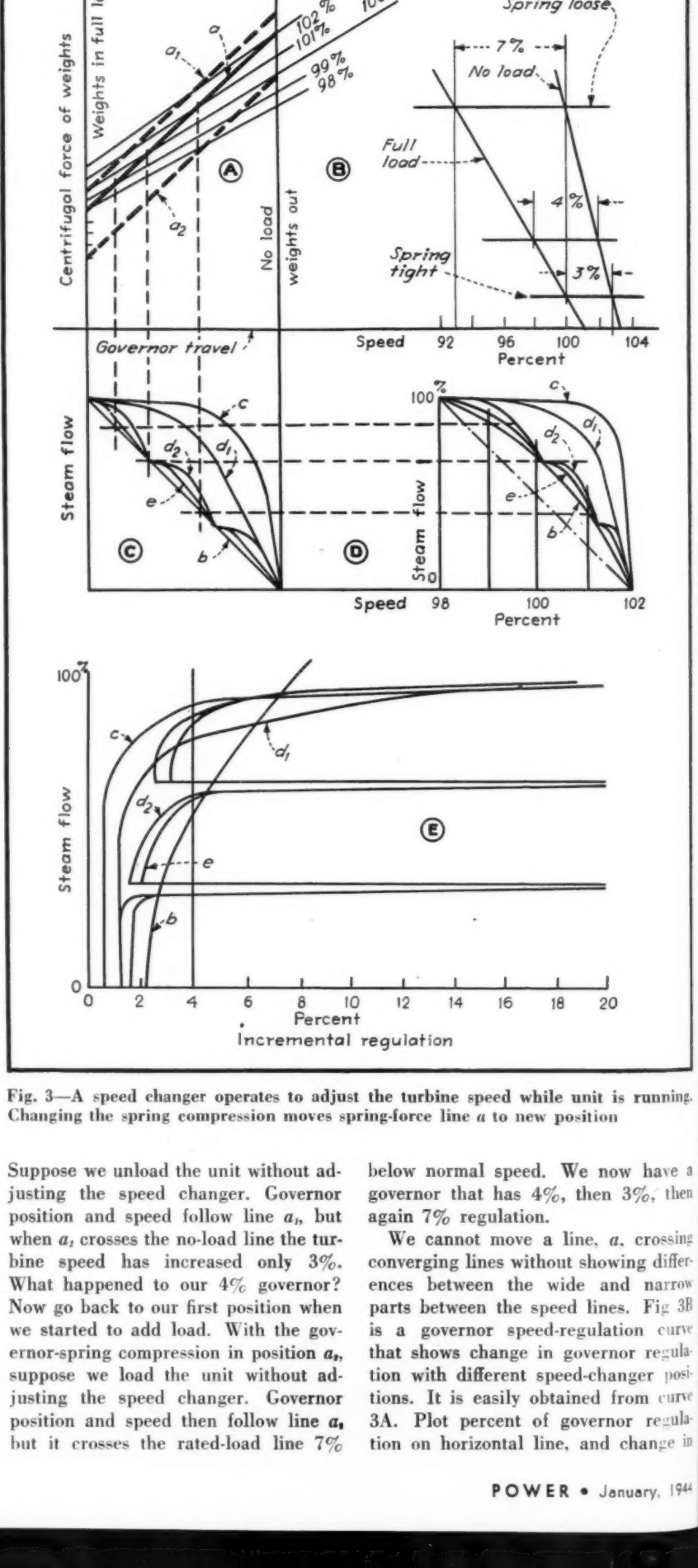



Fig. 3—A speed changer operates to adjust the turbine speed while unit is running. Changing the spring compression moves spring-force line *a* to new position

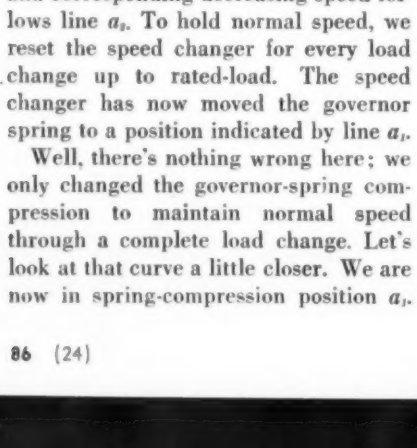



Fig. 5—Double-port valve is balanced at only two points of its travel

speed-changer position on vertical line. Then erect a vertical line at the 100% speed point and draw horizontal lines at the speed changer position that gives 100% speed with no load, then with rated-load. Call the upper line *spring-loose* and the lower one *spring-tight*. Set off the speed change, where $a_1$ crosses the rated-load line, (7%) on the spring-loose line. Connect this point to the intersection of the 100% speed line and spring-tight line. Set off the speed change where $a_1$ crosses the no-load line (3%) on spring-tight line. Connect this point on spring-tight line to the intersection of 100% speed line and spring-loose line. Governor speed regulation for every speed-changer position can then be determined.

### *Ideal Steam Flow*

Fig. 3C shows relation between governor travel and steam flow, straight line *b* showing the ideal condition when steam flow changes proportionately for every governor movement. We can obtain this by connecting the governor to its valve, Fig. 1, by links so proportioned that when the valve is on its seat governor weights are in their no-load weights-out position, and when the governor reaches rated-load weights-in position it lifts the governing valve just the right amount to carry rated-load.

Assuming for a minute that the governor valve changes the steam flow in equal increments with travel, line *b* shows the amount of steam-flow change with the corresponding governor travel. This line loses its straightness if we plot steam flow against speed, Fig. 3D. Dot-and-dash line connecting the 100% steam-flow point with the 102% speed point shows the correct speed-flow characteristics we are striving to obtain. But before we consider anything else, let's change the governor travel—steam-flow line to speed and steam flow. Drop a line from Fig. 3A, where spring-force line *a* crosses the 101% speed line, until it intersects line *b* of Fig. 3C, and bring that intersection over horizontally until it crosses the 101% speed line of Fig. 3D to get the correct steam-flow speed point for 101% speed. Repeating the same process with the intersection of *a* with the 100% and 99% speed lines, we obtain the additional points on Fig. 3D enabling us to lay out curve *b* on the speed-steam flow chart.

Curvature of this line comes from unequal governor travel for an equal speed change. Even with a perfect governor valve, the speed-steam flow line is far from ideal. The real effect of this curve is not fully appreciated until we replot it in Fig. 3E, which is an incremental regulation steam-flow curve.

Incremental regulation of a governor is the regulation at any one load point. Simple—or is it? Suppose we try to convert the governor's speed steam-flow curve, *b*, in Fig. 3D, into an incremental regulation curve. Start at zero steam-flow point and draw a tangent or extend the shape of the curve for, say, one-sixteenth of its length, with a straight line until it crosses the 100% steam-flow point. We find it crosses at a little over the 100% speed point; or slightly more than 2% change in speed is required from zero to 100% steam flow if the initial rate of travel is maintained over the full range of steam flow.

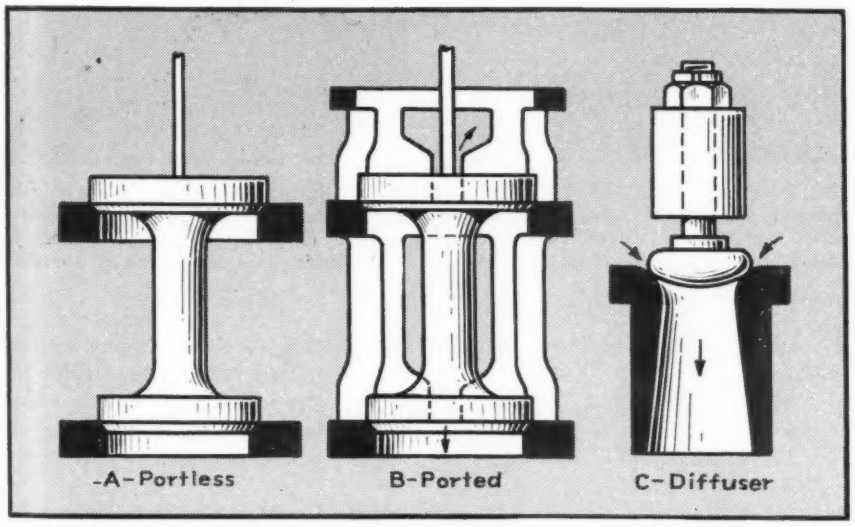



**Fig. 4—Valve shape can help or hinder governor action. Restricted ports at small openings help even out velocity flow over valve travel**

Repeating the same performance at the 100% flow point and extending the tangent to the zero flow line, it crosses somewhat beyond the 106% speed point for a total speed change of 8%. Obtaining a few more points in between allows us to plot curve *b*, Fig. 3E, which does not look like the dot-and-dash line we have been working so hard to obtain. We start with a little more than 2% regulation and end up with 8%; only at one point, around the ½ steam flow, do we actually have 4% regulation. To be exact, we should correct this curve in line with the speed changer curve of Fig. 3B.

We now have to add the peculiarities of governing valves to obtain a final complete picture. Fig. 4A shows a governing valve having full admission without restriction, and admission area changes in direct proportion to lift. Ported valve, Fig. 4B, shows restricted steam admission area by ports located in the valve cage. The third valve, Fig. 4C, with diffuser seat, has characteristics comparable to a plug valve.

Returning to the portless valve, 4A, let's check its travel-flow characteristics. At the valve-open point, with minimum pressure difference, steam flows at only one tenth the velocity it would have when the valve just begins to open. The resultant steam-flow curve *c*, Fig. 3C, is further distorted by the uneven governor travel in Fig. 3D. More than 90% of the steam flow is admitted with only 1% speed change, and the first part of curve is so steep that the incremental regulation for more than one-half steam flow is less than 1%, curve *c*, Fig. 3E.

### *Improves Steam Flow*

A much better steam-flow travel line is obtained if the valve admission area is restricted, Fig. 4B, so that high-velocity steam has considerably less area per valve travel than lower-velocity steam at the valve-open point. Resulting curve $d_1$, Fig. 3C, D and E, shows considerable improvement over curve *c*. A still further improvement can be obtained by using several steam admission points on a unit, each controlled by a separate governing valve, curve $d_2$ on Fig. 3C, D and E. Incremental regulation line shows that, except for the high-regulation points at wide-open valve points, the rest of curve $d_2$ follows incremental regulation curve *b* of the governor closer than curves *c* and $d_1$. Maximum regulation obtained at wide-open valve points could be considerably reduced if final pressure drop across

(*Continued on page* 142)

# How to Avoid Errors In Analyzing High-Moisture Coals

*Lee F Chaney, chemist, Public Service Co of Colorado, describes procedure to eliminate effect of oxidation in analysis of sub-bituminous and lignite*

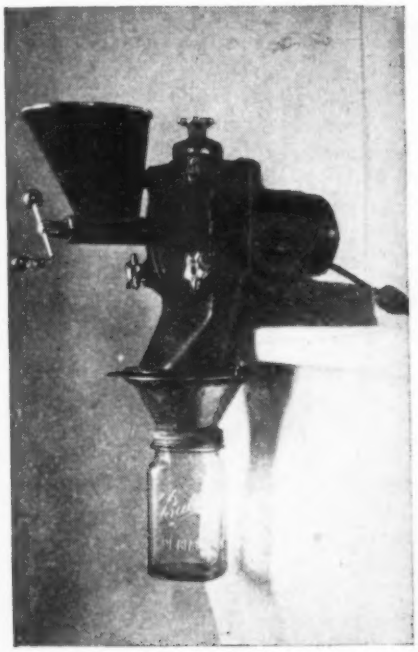


Fig. 1 — Laboratory-pulverizer design minimizes moisture loss during grinding of sample. Mill discharges to quart jar which is later capped with airtight lid

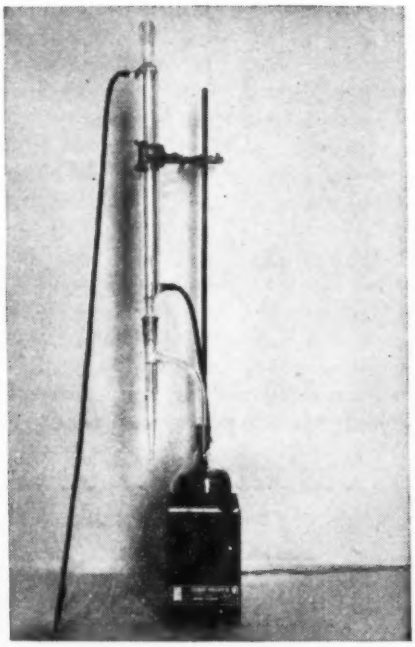


Fig. 2—Flask of this ASTM moisture apparatus contains 100 grams of coal and 200 cc of xylene. After heating, cc of water in trap equals percent moisture

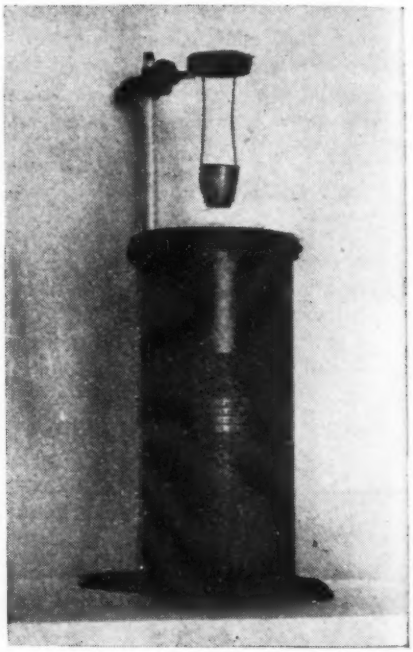


Fig. 3—Furnace for volatile-matter determination of high-moisture coals; method of preheating outlined here in text eliminates loss caused by sparking

► FUEL ANALYSTS have recognized for some time that analytical procedures outlined for low-moisture "harder" coals must be modified for high-moisture coals, particularly sub-bituminous and lignite. These show great affinity for oxygen even at room temperatures; this affinity increases rapidly as temperature rises, introducing errors in analyses made by standard methods. For example, air drying high-moisture coals at some temperature between 90 and 150 F introduces appreciable errors when such coals are subject to low-temperature oxidation, according to Stansfield, Lang and Gilbart [1]. Similar errors arise in the oven method of moisture determination.

Based on considerable experience with Colorado black lignite having a typical *as received* analysis about as follows

| | |
|---|---|
| Moisture, % | 20.3 |
| Volatile matter, % | 30.2 |
| Fixed carbon, % | 45.5 |
| Ash, % | 4.02 |
| Sulphur, % | 0.52 |
| Calorific value, Btu | 10,300 |

the Public Service Company of Colorado now follows methods of analysis believed to practically eliminate the effect of oxidation. Let's look at them.

**Preparation of sample:** A one-quart sample that will pass the ¼-in. sieve goes to the laboratory, where it is emptied into the hopper of a Raymond laboratory pulverizer fitted with a quart Mason jar to receive ground coal, Fig. 1. No moisture loss results because the design minimizes air flow through the mill during the grinding process. The pulverizer grinds the sample to minus 200 mesh in about three minutes. Capping the quart jar with an airtight lid readies the sample for analysis which should follow immediately to prevent oxidation of freshly ground coal.

**Mixing and weighing:** Empty the entire sample of ground coal onto a large piece of paper and mix quickly by rolling. Fill two 2-gram screw-cap vials and cap tightly. Quickly weigh 100 grams of sample and place in a 500-cc special moisture flask, then add 200 cc of xylene. Weighing duplicate Btu samples and volatile and ash samples from the two vials by difference avoids moisture loss during weighings.

**Moisture determination:** An ASTM apparatus, as outlined by method D244-36T for emulsified asphalts, determines moisture. Fit the

(*Continued on page* 192)

[1] "Oxidation of Coal and Relation of Its Analysis" by E Stansfield, W A Lang and K C Gilbart, Edmonton, Alberta. *American Institute of Mining and Metallurgical Engineers*, 1934.

# Correction Factors for Steam Flow

***Most steam flowmeters measure correctly a volume of steam at a specified pressure and temperature. The lb-per-hr reading can quickly be corrected for varying conditions by these tables* prepared by Charles A Pohlig, Union Electric Co of Missouri***

▶ STEAM FLOWMETERS deserve as much attention as a cash register, which they actually are in many cases. If pressure and temperature of steam at the meter vary from the conditions for which the meter was designed, an error in the measured flow occurs and a correction should be made to the lb-per-hr reading.

It is common practice to calculate the correction factor from the specific volume of the steam at specified conditions for the meter and for actual condition of steam flowing through the meter. The square root of the former divided by the square root of the latter gives a correction factor by which the meter reading should be multiplied.

This procedure requires interpolation of steam table quantities and calculation of square roots. Both steps can be eliminated for pressures from zero to 200-psi gage and superheat up to 164 F by use of the following tables. Not only is a considerable time saving possible, but the chances of error are greatly reduced because of the simple calculation involved.

Table I applies to pressure differences only; Table II corrects for differences in superheat only; Table III gives the actual lb-per-hr to be added to the meter reading for a change in superheat for any flow quantity.

For example, a meter intended for measuring steam at 100-psi gage, dry saturated, reads 5000 lb per hr when actually passing steam at 50 psi, dry

* Republication rights reserved

## TABLE I—CORRECTION FOR STEAM PRESSURE

| Pressure, psi gage | Temp sat steam, F | $\sqrt{v}$ * | Pressure, psi gage | Temp sat steam, F | $\sqrt{v}$ * | Pressure, psi gage | Temp sat steam, F | $\sqrt{v}$ * | Pressure, psi gage | Temp sat steam, F | $\sqrt{v}$ * | Pressure, psi gage | Temp sat steam, F | $\sqrt{v}$ * |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 212 | 5.1788 | 41 | 288 | 2.7664 | 82 | 326 | 2.1347 | 123 | 352 | 1.8056 | 164 | 373 | 1.5944 |
| 1 | 216 | 4.9759 | 42 | 289 | 2.7435 | 83 | 326 | 2.1241 | 124 | 352 | 1.7995 | 165 | 373 | 1.5903 |
| 2 | 219 | 4.8374 | 43 | 291 | 2.7213 | 84 | 327 | 2.1137 | 125 | 353 | 1.7933 | 166 | 374 | 1.5859 |
| 3 | 222 | 4.7096 | 44 | 292 | 2.6994 | 85 | 328 | 2.1038 | 126 | 354 | 1.7871 | 167 | 374 | 1.5818 |
| 4 | 225 | 4.5912 | 45 | 293 | 2.6781 | 86 | 329 | 2.0940 | 127 | 354 | 1.7813 | 168 | 374 | 1.5776 |
| 5 | 228 | 4.4827 | 46 | 294 | 2.6574 | 87 | 329 | 2.0842 | 128 | 355 | 1.7751 | 169 | 375 | 1.5735 |
| 6 | 231 | 4.3814 | 47 | 295 | 2.6372 | 88 | 330 | 2.0748 | 129 | 355 | 1.7692 | 170 | 375 | 1.5694 |
| 7 | 233 | 4.2872 | 48 | 296 | 2.6172 | 89 | 331 | 2.0652 | 130 | 356 | 1.7635 | 171 | 376 | 1.5656 |
| 8 | 235 | 4.1988 | 49 | 297 | 2.5979 | 90 | 331 | 2.0557 | 131 | 356 | 1.7576 | 172 | 376 | 1.5614 |
| 9 | 238 | 4.1159 | 50 | 298 | 2.5791 | 91 | 332 | 2.0467 | 132 | 357 | 1.7519 | 173 | 377 | 1.5573 |
| 10 | 240 | 4.0380 | 51 | 299 | 2.5606 | 92 | 333 | 2.0377 | 133 | 357 | 1.7461 | 174 | 377 | 1.5534 |
| 11 | 242 | 3.9646 | 52 | 300 | 2.5424 | 93 | 333 | 2.0285 | 134 | 358 | 1.7407 | 175 | 378 | 1.5495 |
| 12 | 244 | 3.8951 | 53 | 301 | 2.5249 | 94 | 334 | 2.0196 | 135 | 358 | 1.7349 | 176 | 378 | 1.5456 |
| 13 | 246 | 3.8293 | 54 | 302 | 2.5076 | 95 | 335 | 2.0109 | 136 | 359 | 1.7295 | 177 | 378 | 1.5418 |
| 14 | 248 | 3.7670 | 55 | 303 | 2.4906 | 96 | 335 | 2.0025 | 137 | 359 | 1.7240 | 178 | 379 | 1.5379 |
| 15 | 250 | 3.7074 | 56 | 304 | 2.4741 | 97 | 336 | 1.9940 | 138 | 360 | 1.7187 | 179 | 379 | 1.5339 |
| 16 | 252 | 3.6510 | 57 | 305 | 2.4578 | 98 | 337 | 1.9857 | 139 | 361 | 1.7132 | 180 | 380 | 1.5304 |
| 17 | 254 | 3.5972 | 58 | 306 | 2.4419 | 99 | 337 | 1.9774 | 140 | 361 | 1.7079 | 181 | 380 | 1.5264 |
| 18 | 256 | 3.5458 | 59 | 307 | 2.4263 | 100 | 338 | 1.9692 | 141 | 362 | 1.7029 | 182 | 381 | 1.5228 |
| 19 | 258 | 3.4966 | 60 | 308 | 2.4110 | 101 | 339 | 1.9611 | 142 | 362 | 1.6977 | 183 | 381 | 1.5189 |
| 20 | 259 | 3.4493 | 61 | 309 | 2.3960 | 102 | 339 | 1.9532 | 143 | 363 | 1.6923 | 184 | 381 | 1.5153 |
| 21 | 261 | 3.4039 | 62 | 309 | 2.3814 | 103 | 340 | 1.9452 | 144 | 363 | 1.6873 | 185 | 382 | 1.5116 |
| 22 | 263 | 3.3606 | 63 | 310 | 2.3668 | 104 | 341 | 1.9375 | 145 | 364 | 1.6823 | 186 | 382 | 1.5080 |
| 23 | 264 | 3.3189 | 64 | 311 | 2.3527 | 105 | 341 | 1.9300 | 146 | 364 | 1.6775 | 187 | 383 | 1.5043 |
| 24 | 266 | 3.2787 | 65 | 312 | 2.3388 | 106 | 342 | 1.9227 | 147 | 365 | 1.6724 | 188 | 383 | 1.5007 |
| 25 | 267 | 3.2399 | 66 | 313 | 2.3251 | 107 | 343 | 1.9157 | 148 | 365 | 1.6676 | 189 | 383 | 1.4973 |
| 26 | 269 | 3.2027 | 67 | 314 | 2.3115 | 108 | 343 | 1.9084 | 149 | 366 | 1.6625 | 190 | 384 | 1.4937 |
| 27 | 270 | 3.1665 | 68 | 315 | 2.2983 | 109 | 344 | 1.9013 | 150 | 366 | 1.6577 | 191 | 384 | 1.4903 |
| 28 | 272 | 3.1318 | 69 | 315 | 2.2852 | 110 | 344 | 1.8939 | 151 | 367 | 1.6532 | 192 | 384 | 1.4866 |
| 29 | 273 | 3.0982 | 70 | 316 | 2.2724 | 111 | 345 | 1.8868 | 152 | 367 | 1.6484 | 193 | 385 | 1.4832 |
| 30 | 274 | 3.0658 | 71 | 317 | 2.2599 | 112 | 346 | 1.8794 | 153 | 367 | 1.6435 | 194 | 385 | 1.4799 |
| 31 | 276 | 3.0343 | 72 | 318 | 2.2474 | 113 | 346 | 1.8721 | 154 | 368 | 1.6389 | 195 | 386 | 1.4765 |
| 32 | 277 | 3.0038 | 73 | 319 | 2.2354 | 114 | 347 | 1.8647 | 155 | 368 | 1.6343 | 196 | 386 | 1.4731 |
| 33 | 278 | 2.9742 | 74 | 319 | 2.2235 | 115 | 347 | 1.8577 | 156 | 369 | 1.6297 | 197 | 387 | 1.4697 |
| 34 | 280 | 2.9455 | 75 | 320 | 2.2118 | 116 | 348 | 1.8509 | 157 | 369 | 1.6251 | 198 | 387 | 1.4663 |
| 35 | 281 | 2.9178 | 76 | 321 | 2.2002 | 117 | 348 | 1.8442 | 158 | 370 | 1.6205 | 199 | 388 | 1.4632 |
| 36 | 282 | 2.8908 | 77 | 322 | 2.1888 | 118 | 349 | 1.8376 | 159 | 370 | 1.6162 | 200 | 388 | 1.4598 |
| 37 | 283 | 2.8646 | 78 | 323 | 2.1776 | 119 | 350 | 1.8311 | 160 | 371 | 1.6118 | | | |
| 38 | 285 | 2.8390 | 79 | 323 | 2.1666 | 120 | 350 | 1.8245 | 161 | 371 | 1.6075 | | | |
| 39 | 286 | 2.8140 | 80 | 324 | 2.1557 | 121 | 351 | 1.8182 | 162 | 372 | 1.6031 | | | |
| 40 | 287 | 2.7898 | 81 | 325 | 2.1452 | 122 | 351 | 1.8119 | 163 | 372 | 1.5987 | | | |

* Square root of $v$, volume of saturated steam, cu ft per lb. Based on *Thermodynamic Properties of Steam* by Keenan & Keyes, John Wiley & Sons, Inc., 1936 edition.

saturated. From Table I the correction factor for 100 psi is 1.9692. For 50 psi, the factor is 2.5791. Divide 1.9692 by 2.5791 to get a correction factor of 0.7635 and a flow of 5000x0.7635 = 3817 lb per hr actually passing the meter. This illustrates use of the tables to correct for pressure variation only. Use, of course, only as many places in the correction-factor calculation as are justified by the accuracy required.

If the temperature changes but the pressure remains constant, use Table II. For example, a meter designed for 100-psi gage and 80-F superheat is actually handling steam at 100 psi, dry saturated. From Table II opposite 80 F the correction factor is 1.06214. For dry saturated steam the factor, of course, is 1.0. Thus the combined correction factor is 1.06214 divided by 1.0 or 1.06214. If the flowmeter reading is 5000 lb per hr the actual flow of dry saturated steam is 5000x1.06214 = 5311 lb per hr.

Usually both temperature and pressure variations are experienced. If, for example, a meter designed for 10-psi gage and 20-F superheat operates at 60-psi gage and 32-F superheat, the actual flow would be calculated as follows:

From Table I the correction factor for 10 psi is 4.0380 and from Table II the factor for 20-F superheat is 1.01667. The combined correction factor is 4.0380x1.01667 = 4.1053. For actual steam conditions, Table I shows for 60 psi a factor of 2.4110 and Table II for 32-F superheat, 1.02615. The combined factor is 2.4110x1.02615 = 2.4740. Dividing the combined factor for meter

(*Continued on page* 144)

## TABLE II

| Superheat, F | Corr Factor | Superheat, F | Corr Factor |
|---|---|---|---|
| 0=Dry Sat | 1.00000 | 21 | 1.01750 |
| 1 | 1.00083 | 22 | 1.01833 |
| 2 | 1.00167 | 23 | 1.01917 |
| 3 | 1.00250 | 24 | 1.02000 |
| 4 | 1.00333 | 25 | 1.02077 |
| 5 | 1.00417 | 26 | 1.02154 |
| 6 | 1.00500 | 27 | 1.02231 |
| 7 | 1.00583 | 28 | 1.02308 |
| 8 | 1.00667 | 29 | 1.02385 |
| 9 | 1.00750 | 30 | 1.02462 |
| 10 | 1.00833 | 31 | 1.02538 |
| 11 | 1.00917 | 32 | 1.02615 |
| 12 | 1.01000 | 33 | 1.02692 |
| 13 | 1.01083 | 34 | 1.02769 |
| 14 | 1.01167 | 35 | 1.02846 |
| 15 | 1.01250 | 36 | 1.02923 |
| 16 | 1.01333 | 37 | 1.03000 |
| 17 | 1.01417 | 38 | 1.03077 |
| 18 | 1.01500 | 39 | 1.03154 |
| 19 | 1.01583 | 40 | 1.03231 |
| 20 | 1.01667 | 41 | 1.03308 |

## TABLE III—POUNDS TO

| Superheat F | Factor | Measured Flow 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dry Sat | 1.00000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1.00083 | 0.08 | 0.16 | 0.25 | 0.33 | 0.42 | 0.50 | 0.58 | 0.66 | 0.75 | 0.83 |
| 2 | 1.00167 | 0.17 | 0.33 | 0.50 | 0.67 | 0.84 | 1.00 | 1.17 | 1.34 | 1.50 | 1.67 |
| 3 | 1.00250 | 0.25 | 0.50 | 0.75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 |
| 4 | 1.00333 | 0.33 | 0.67 | 1.00 | 1.33 | 1.67 | 2.00 | 2.33 | 2.66 | 3.00 | 3.33 |
| 5 | 1.00417 | 0.42 | 0.83 | 1.25 | 1.67 | 2.09 | 2.50 | 2.92 | 3.34 | 3.75 | 4.17 |
| 6 | 1.00500 | 0.50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 |
| 7 | 1.00583 | 0.58 | 1.17 | 1.75 | 2.33 | 2.92 | 3.50 | 4.08 | 4.66 | 5.25 | 5.83 |
| 8 | 1.00667 | 0.67 | 1.33 | 2.00 | 2.67 | 3.34 | 4.00 | 4.67 | 5.34 | 6.00 | 6.67 |
| 9 | 1.00750 | 0.75 | 1.50 | 2.25 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 10 | 1.00833 | 0.83 | 1.67 | 2.50 | 3.33 | 4.17 | 5.00 | 5.83 | 6.66 | 7.50 | 8.33 |
| 11 | 1.00917 | 0.92 | 1.83 | 2.75 | 3.67 | 4.59 | 5.50 | 6.42 | 7.34 | 8.25 | 9.17 |
| 12 | 1.01000 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.00 |
| 13 | 1.01083 | 1.08 | 2.17 | 3.25 | 4.33 | 5.42 | 6.50 | 7.58 | 8.66 | 9.75 | 10.83 |
| 14 | 1.01167 | 1.17 | 2.33 | 3.50 | 4.67 | 5.84 | 7.00 | 8.17 | 9.34 | 10.50 | 11.67 |
| 15 | 1.01250 | 1.25 | 2.50 | 3.75 | 5.00 | 6.25 | 7.50 | 8.75 | 10.00 | 11.25 | 12.50 |
| 16 | 1.01333 | 1.33 | 2.67 | 4.00 | 5.33 | 6.67 | 8.00 | 9.33 | 10.66 | 12.00 | 13.33 |
| 17 | 1.01417 | 1.42 | 2.83 | 4.25 | 5.67 | 7.09 | 8.50 | 9.92 | 11.34 | 12.75 | 14.17 |
| 18 | 1.01500 | 1.50 | 3.00 | 4.50 | 6.00 | 7.50 | 9.00 | 10.50 | 12.00 | 13.50 | 15.00 |
| 19 | 1.01583 | 1.58 | 3.17 | 4.75 | 6.33 | 7.92 | 9.50 | 11.08 | 12.66 | 14.25 | 15.83 |
| 20 | 1.01667 | 1.67 | 3.33 | 5.00 | 6.67 | 8.34 | 10.00 | 11.67 | 13.34 | 15.00 | 16.67 |
| 21 | 1.01750 | 1.75 | 3.50 | 5.25 | 7.00 | 8.75 | 10.50 | 12.25 | 14.00 | 15.75 | 17.50 |
| 22 | 1.01833 | 1.83 | 3.67 | 5.50 | 7.33 | 9.17 | 11.00 | 12.83 | 14.66 | 16.50 | 18.33 |
| 23 | 1.01917 | 1.92 | 3.83 | 5.75 | 7.67 | 9.59 | 11.50 | 13.42 | 15.34 | 17.25 | 19.17 |
| 24 | 1.02000 | 2.00 | 4.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 |
| 25 | 1.02077 | 2.08 | 4.15 | 6.23 | 8.31 | 10.39 | 12.46 | 14.54 | 16.62 | 18.69 | 20.77 |
| 26 | 1.02154 | 2.15 | 4.31 | 6.46 | 8.62 | 10.77 | 12.92 | 15.08 | 17.23 | 19.39 | 21.54 |
| 27 | 1.02231 | 2.23 | 4.46 | 6.69 | 8.92 | 11.16 | 13.39 | 15.62 | 17.85 | 20.08 | 22.31 |
| 28 | 1.02308 | 2.31 | 4.62 | 6.92 | 9.23 | 11.54 | 13.85 | 16.16 | 18.46 | 20.77 | 23.08 |
| 29 | 1.02385 | 2.39 | 4.77 | 7.16 | 9.54 | 11.93 | 14.31 | 16.70 | 19.08 | 21.47 | 23.85 |
| 30 | 1.02462 | 2.46 | 4.92 | 7.39 | 9.85 | 12.31 | 14.77 | 17.23 | 19.70 | 22.16 | 24.62 |
| 31 | 1.02538 | 2.54 | 5.08 | 7.61 | 10.15 | 12.69 | 15.23 | 17.77 | 20.30 | 22.84 | 25.38 |
| 32 | 1.02615 | 2.62 | 5.23 | 7.85 | 10.46 | 13.08 | 15.69 | 18.31 | 20.92 | 23.54 | 26.15 |
| 33 | 1.02692 | 2.69 | 5.38 | 8.09 | 10.77 | 13.46 | 16.15 | 18.84 | 21.54 | 24.23 | 26.92 |
| 34 | 1.02769 | 2.77 | 5.54 | 8.31 | 11.08 | 13.85 | 16.61 | 19.38 | 22.15 | 24.92 | 27.69 |
| 35 | 1.02846 | 2.85 | 5.69 | 8.54 | 11.38 | 14.23 | 17.08 | 19.92 | 22.77 | 25.61 | 28.46 |
| 36 | 1.02923 | 2.92 | 5.85 | 8.77 | 11.69 | 14.62 | 17.54 | 20.46 | 23.38 | 26.31 | 29.24 |
| 37 | 1.03000 | 3.00 | 6.00 | 9.00 | 12.00 | 15.00 | 18.00 | 21.00 | 24.00 | 27.00 | 30.01 |
| 38 | 1.03077 | 3.08 | 6.15 | 9.23 | 12.31 | 15.39 | 18.46 | 21.54 | 24.62 | 27.69 | 30.78 |
| 39 | 1.03154 | 3.15 | 6.31 | 9.46 | 12.62 | 15.77 | 18.92 | 22.08 | 25.23 | 28.39 | 31.54 |
| 40 | 1.03231 | 3.23 | 6.46 | 9.69 | 12.92 | 16.16 | 19.39 | 22.62 | 25.85 | 29.08 | 32.31 |
| 41 | 1.03308 | 3.31 | 6.62 | 9.92 | 13.23 | 16.54 | 19.85 | 23.16 | 26.46 | 29.77 | 33.08 |
| 42 | 1.03385 | 3.39 | 6.77 | 10.16 | 13.54 | 16.93 | 20.31 | 23.70 | 27.08 | 30.47 | 33.85 |
| 43 | 1.03462 | 3.46 | 6.92 | 10.39 | 13.85 | 17.31 | 20.77 | 24.23 | 27.70 | 31.16 | 34.62 |
| 44 | 1.03538 | 3.54 | 7.08 | 10.61 | 14.15 | 17.69 | 21.23 | 24.77 | 28.30 | 31.84 | 35.38 |
| 45 | 1.03615 | 3.62 | 7.23 | 10.85 | 14.46 | 18.08 | 21.69 | 25.31 | 28.92 | 32.54 | 36.15 |
| 46 | 1.03692 | 3.69 | 7.38 | 11.08 | 14.77 | 18.46 | 22.15 | 25.84 | 29.54 | 33.23 | 36.92 |
| 47 | 1.03769 | 3.77 | 7.54 | 11.31 | 15.08 | 18.85 | 22.61 | 26.38 | 30.15 | 33.92 | 37.69 |

| Superheat F | Factor | Measured Flow 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|
| 48 | 1.03846 | 3.85 | 7.69 | 11.54 | 15.38 |
| 49 | 1.03923 | 3.92 | 7.85 | 11.77 | 15.69 |
| 50 | 1.04000 | 4.00 | 8.00 | 12.00 | 16.00 |
| 51 | 1.04077 | 4.08 | 8.15 | 12.23 | 16.31 |
| 52 | 1.04154 | 4.15 | 8.31 | 12.46 | 16.62 |
| 53 | 1.04231 | 4.23 | 8.46 | 12.69 | 16.92 |
| 54 | 1.04308 | 4.31 | 8.62 | 12.92 | 17.23 |
| 55 | 1.04385 | 4.39 | 8.77 | 13.16 | 17.54 |
| 56 | 1.04462 | 4.46 | 8.92 | 13.39 | 17.85 |
| 57 | 1.04538 | 4.54 | 9.08 | 13.61 | 18.15 |
| 58 | 1.04615 | 4.62 | 9.23 | 13.85 | 18.46 |
| 59 | 1.04692 | 4.69 | 9.38 | 14.08 | 18.77 |
| 60 | 1.04769 | 4.77 | 9.54 | 14.31 | 19.08 |
| 61 | 1.04846 | 4.85 | 9.70 | 14.55 | 19.40 |
| 62 | 1.04923 | 4.92 | 9.85 | 14.77 | 19.69 |
| 63 | 1.05000 | 5.00 | 10.00 | 15.00 | 20.00 |
| 64 | 1.05071 | 5.07 | 10.14 | 15.21 | 20.28 |
| 65 | 1.05143 | 5.14 | 10.29 | 15.43 | 20.57 |
| 66 | 1.05214 | 5.21 | 10.43 | 15.64 | 20.86 |
| 67 | 1.05286 | 5.29 | 10.57 | 15.86 | 21.14 |
| 68 | 1.05357 | 5.36 | 10.71 | 16.07 | 21.43 |
| 69 | 1.05429 | 5.43 | 10.86 | 16.29 | 21.72 |
| 70 | 1.05500 | 5.50 | 11.00 | 16.50 | 22.00 |
| 71 | 1.05571 | 5.57 | 11.14 | 16.71 | 22.28 |
| 72 | 1.05643 | 5.64 | 11.29 | 16.93 | 22.57 |
| 73 | 1.05714 | 5.71 | 11.43 | 17.14 | 22.86 |
| 74 | 1.05786 | 5.79 | 11.57 | 17.36 | 23.14 |
| 75 | 1.05857 | 5.86 | 11.71 | 17.57 | 23.43 |
| 76 | 1.05929 | 5.93 | 11.86 | 17.79 | 23.72 |
| 77 | 1.06000 | 6.00 | 12.00 | 18.00 | 24.00 |
| 78 | 1.06071 | 6.07 | 12.14 | 18.21 | 24.28 |
| 79 | 1.06143 | 6.14 | 12.29 | 18.43 | 24.57 |
| 80 | 1.06214 | 6.21 | 12.43 | 18.64 | 24.86 |
| 81 | 1.06286 | 6.29 | 12.57 | 18.86 | 25.14 |
| 82 | 1.06357 | 6.36 | 12.71 | 19.07 | 25.43 |
| 83 | 1.06429 | 6.43 | 12.86 | 19.29 | 25.72 |
| 84 | 1.06500 | 6.50 | 13.00 | 19.50 | 26.00 |
| 85 | 1.06571 | 6.57 | 13.14 | 19.71 | 26.28 |
| 86 | 1.06643 | 6.64 | 13.29 | 19.93 | 26.57 |
| 87 | 1.06714 | 6.71 | 13.43 | 20.14 | 26.86 |
| 88 | 1.06786 | 6.79 | 13.57 | 20.36 | 27.14 |
| 89 | 1.06857 | 6.86 | 13.71 | 20.57 | 27.43 |
| 90 | 1.06929 | 6.93 | 13.86 | 20.79 | 27.72 |
| 91 | 1.07000 | 7.00 | 14.00 | 21.00 | 28.00 |
| 92 | 1.07071 | 7.07 | 14.14 | 21.21 | 28.28 |
| 93 | 1.07143 | 7.14 | 14.29 | 21.43 | 28.57 |
| 94 | 1.07214 | 7.21 | 14.43 | 21.64 | 28.86 |
| 95 | 1.07286 | 7.29 | 14.57 | 21.86 | 29.14 |

## SUPERHEAT CORRECTION FACTOR

| Superheat, F | Corr Factor | Superheat, F | Corr Factor | Superheat, F | Corr Factor | Superheat, F | Corr Factor | Superheat, F | Corr Factor | Superheat, F | Corr Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | 1.03385 | 63 | 1.05000 | 84 | 1.06500 | 105 | 1.08000 | 126 | 1.09466 | 147 | 1.10866 |
| 43 | 1.03462 | 64 | 1.05071 | 85 | 1.06571 | 106 | 1.08071 | 127 | 1.09533 | 148 | 1.10933 |
| 44 | 1.03538 | 65 | 1.05143 | 86 | 1.06643 | 107 | 1.08143 | 128 | 1.09600 | 149 | 1.11000 |
| 45 | 1.03615 | 66 | 1.05214 | 87 | 1.06714 | 108 | 1.08214 | 129 | 1.09666 | 150 | 1.11066 |
| 46 | 1.03692 | 67 | 1.05286 | 88 | 1.06786 | 109 | 1.08286 | 130 | 1.09733 | 151 | 1.11133 |
| 47 | 1.03769 | 68 | 1.05357 | 89 | 1.06857 | 110 | 1.08357 | 131 | 1.09800 | 152 | 1.11200 |
| 48 | 1.03846 | 69 | 1.05429 | 90 | 1.06929 | 111 | 1.08429 | 132 | 1.09866 | 153 | 1.11266 |
| 49 | 1.03923 | 70 | 1.05500 | 91 | 1.07000 | 112 | 1.08500 | 133 | 1.09933 | 154 | 1.11333 |
| 50 | 1.04000 | 71 | 1.05571 | 92 | 1.07071 | 113 | 1.08571 | 134 | 1.10000 | 155 | 1.11400 |
| 51 | 1.04077 | 72 | 1.05643 | 93 | 1.07143 | 114 | 1.08643 | 135 | 1.10066 | 156 | 1.11466 |
| 52 | 1.04154 | 73 | 1.05714 | 94 | 1.07214 | 115 | 1.08714 | 136 | 1.10133 | 157 | 1.11533 |
| 53 | 1.04231 | 74 | 1.05786 | 95 | 1.07286 | 116 | 1.08786 | 137 | 1.10200 | 158 | 1.11600 |
| 54 | 1.04308 | 75 | 1.05857 | 96 | 1.07357 | 117 | 1.08857 | 138 | 1.10266 | 159 | 1.11666 |
| 55 | 1.04385 | 76 | 1.05929 | 97 | 1.07429 | 118 | 1.08929 | 139 | 1.10333 | 160 | 1.11733 |
| 56 | 1.04462 | 77 | 1.06000 | 98 | 1.07500 | 119 | 1.09000 | 140 | 1.10400 | 161 | 1.11800 |
| 57 | 1.04538 | 78 | 1.06071 | 99 | 1.07571 | 120 | 1.09066 | 141 | 1.10466 | 162 | 1.11866 |
| 58 | 1.04615 | 69 | 1.06143 | 100 | 1.07643 | 121 | 1.09133 | 142 | 1.10533 | 163 | 1.11933 |
| 59 | 1.04692 | 80 | 1.06214 | 101 | 1.07714 | 122 | 1.09200 | 143 | 1.10600 | 164 | 1.12000 |
| 60 | 1.04769 | 81 | 1.06286 | 102 | 1.07786 | 123 | 1.09266 | 144 | 1.10666 | | |
| 61 | 1.04846 | 82 | 1.06357 | 103 | 1.07857 | 124 | 1.09333 | 145 | 1.10733 | | |
| 62 | 1.04923 | 83 | 1.06429 | 104 | 1.07929 | 125 | 1.09400 | 146 | 1.10800 | | |

## BE ADDED TO MEASURED FLOW

| 500 | 600 | 700 | 800 | 900 | 1000 |
|---|---|---|---|---|---|
| 19.23 | 23.08 | 26.92 | 30.77 | 34.61 | 38.46 |
| 19.62 | 23.54 | 27.46 | 31.38 | 35.31 | 39.23 |
| 20.00 | 24.00 | 28.00 | 32.00 | 36.00 | 40.00 |
| 20.39 | 24.46 | 28.54 | 32.62 | 36.69 | 40.77 |
| 20.77 | 24.92 | 29.08 | 33.23 | 37.39 | 41.54 |
| 21.16 | 25.39 | 29.62 | 33.85 | 38.08 | 42.31 |
| 21.54 | 25.85 | 30.16 | 34.46 | 38.77 | 43.08 |
| 21.93 | 26.31 | 30.70 | 35.08 | 39.47 | 43.85 |
| 22.31 | 26.77 | 31.23 | 35.70 | 40.16 | 44.62 |
| 22.69 | 27.23 | 31.77 | 36.30 | 40.84 | 45.38 |
| 23.08 | 27.69 | 32.31 | 36.92 | 41.54 | 46.15 |
| 23.46 | 28.15 | 32.84 | 37.54 | 42.23 | 46.92 |
| 23.85 | 28.61 | 33.38 | 38.15 | 42.92 | 47.69 |
| 24.25 | 29.10 | 33.95 | 38.80 | 43.65 | 48.46 |
| 24.62 | 29.54 | 34.46 | 39.38 | 44.31 | 49.23 |
| 25.00 | 30.00 | 35.00 | 40.00 | 45.00 | 50.00 |
| 25.36 | 30.43 | 35.50 | 40.57 | 45.64 | 50.71 |
| 25.72 | 30.86 | 36.00 | 41.14 | 46.29 | 51.43 |
| 26.07 | 31.28 | 36.50 | 41.71 | 46.93 | 52.14 |
| 26.43 | 31.72 | 37.00 | 42.29 | 47.57 | 52.86 |
| 26.79 | 32.14 | 37.50 | 42.86 | 48.21 | 53.57 |
| 27.15 | 32.57 | 38.00 | 43.43 | 48.86 | 54.29 |
| 27.50 | 33.00 | 38.50 | 44.00 | 49.50 | 55.00 |
| 27.86 | 33.43 | 39.00 | 44.57 | 50.14 | 55.71 |
| 28.22 | 33.86 | 39.50 | 45.14 | 50.79 | 56.43 |
| 28.57 | 34.28 | 40.00 | 45.71 | 51.43 | 57.14 |
| 28.93 | 34.72 | 40.50 | 46.29 | 52.07 | 57.86 |
| 29.29 | 35.14 | 50.00 | 46.86 | 52.71 | 58.57 |
| 29.65 | 35.57 | 41.50 | 47.43 | 53.36 | 59.29 |
| 30.00 | 36.00 | 42.00 | 48.00 | 54.00 | 60.00 |
| 30.36 | 36.43 | 42.50 | 48.57 | 54.64 | 60.71 |
| 30.72 | 36.86 | 43.00 | 49.14 | 55.29 | 61.43 |
| 31.07 | 37.28 | 43.50 | 49.71 | 55.93 | 62.14 |
| 31.43 | 37.72 | 44.00 | 50.29 | 56.57 | 62.86 |
| 31.79 | 38.14 | 44.50 | 50.86 | 57.21 | 63.57 |
| 32.15 | 38.57 | 45.00 | 51.43 | 57.86 | 64.29 |
| 32.50 | 39.00 | 45.50 | 52.00 | 58.50 | 65.00 |
| 32.86 | 39.43 | 46.00 | 52.57 | 59.14 | 65.71 |
| 33.22 | 39.86 | 46.50 | 53.14 | 59.79 | 66.43 |
| 33.57 | 40.28 | 47.00 | 53.71 | 60.43 | 67.14 |
| 33.93 | 40.72 | 47.50 | 54.29 | 61.07 | 67.86 |
| 34.29 | 41.14 | 48.00 | 54.86 | 61.71 | 68.57 |
| 34.65 | 41.57 | 48.50 | 55.43 | 62.36 | 69.29 |
| 35.00 | 42.00 | 49.00 | 56.00 | 63.00 | 70.00 |
| 35.36 | 42.43 | 49.50 | 56.57 | 63.64 | 70.71 |
| 35.72 | 42.86 | 50.00 | 57.14 | 64.29 | 71.43 |
| 36.07 | 43.28 | 50.50 | 57.71 | 64.93 | 72.14 |
| 36.43 | 43.72 | 51.00 | 58.29 | 65.57 | 72.86 |

| Superheat F | Factor | Measured Flow 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 96 | 1.07357 | 7.36 | 14.71 | 22.07 | 29.43 | 36.79 | 44.14 | 51.50 | 58.86 | 66.21 | 73.57 |
| 97 | 1.07429 | 7.43 | 14.86 | 22.29 | 29.72 | 37.15 | 44.57 | 52.00 | 59.43 | 66.86 | 74.29 |
| 98 | 1.07500 | 7.50 | 15.00 | 22.50 | 30.00 | 37.50 | 45.00 | 52.50 | 60.00 | 67.50 | 75.00 |
| 99 | 1.07571 | 7.57 | 15.14 | 22.71 | 30.28 | 37.86 | 45.43 | 53.00 | 60.57 | 68.14 | 75.71 |
| 100 | 1.07643 | 7.64 | 15.29 | 22.93 | 30.57 | 38.22 | 45.86 | 53.50 | 61.14 | 68.79 | 76.43 |
| 101 | 1.07714 | 7.71 | 15.43 | 23.14 | 30.86 | 38.57 | 46.28 | 54.00 | 61.71 | 69.43 | 77.14 |
| 102 | 1.07786 | 7.79 | 15.57 | 23.36 | 31.14 | 38.93 | 46.72 | 54.50 | 62.29 | 70.07 | 77.86 |
| 103 | 1.07857 | 7.86 | 15.71 | 23.57 | 31.43 | 39.29 | 47.14 | 55.00 | 62.86 | 70.71 | 78.57 |
| 104 | 1.07929 | 7.93 | 15.86 | 23.79 | 31.72 | 39.65 | 47.57 | 55.50 | 63.43 | 71.36 | 79.29 |
| 105 | 1.08000 | 8.00 | 16.00 | 24.00 | 32.00 | 40.00 | 48.00 | 56.00 | 64.00 | 72.00 | 80.00 |
| 106 | 1.08071 | 8.07 | 16.14 | 24.21 | 32.28 | 40.36 | 48.43 | 56.50 | 64.57 | 72.64 | 80.71 |
| 107 | 1.08143 | 8.14 | 16.29 | 24.43 | 32.57 | 40.72 | 48.86 | 57.00 | 65.14 | 73.29 | 81.43 |
| 108 | 1.08214 | 8.21 | 16.43 | 24.64 | 32.86 | 41.07 | 49.28 | 57.50 | 65.71 | 73.93 | 82.14 |
| 109 | 1.08286 | 8.29 | 16.57 | 24.86 | 33.14 | 41.43 | 49.72 | 58.00 | 66.29 | 74.57 | 82.86 |
| 110 | 1.08357 | 8.36 | 16.71 | 25.07 | 33.43 | 41.79 | 50.14 | 58.50 | 66.86 | 75.21 | 83.57 |
| 111 | 1.08429 | 8.43 | 16.86 | 25.29 | 33.72 | 42.15 | 50.57 | 59.00 | 67.43 | 75.86 | 84.29 |
| 112 | 1.08500 | 8.50 | 17.00 | 25.50 | 34.00 | 42.50 | 51.00 | 59.50 | 68.00 | 76.50 | 85.00 |
| 113 | 1.08571 | 8.57 | 17.14 | 25.71 | 34.28 | 42.86 | 51.43 | 60.00 | 68.57 | 77.14 | 85.71 |
| 114 | 1.08643 | 8.64 | 17.29 | 25.93 | 34.57 | 43.22 | 51.86 | 60.50 | 69.14 | 77.79 | 86.43 |
| 115 | 1.08714 | 8.71 | 17.43 | 26.14 | 34.86 | 43.57 | 52.28 | 61.00 | 69.71 | 78.43 | 87.14 |
| 116 | 1.08786 | 8.79 | 17.57 | 26.36 | 35.14 | 43.93 | 52.72 | 61.50 | 70.29 | 79.07 | 87.86 |
| 117 | 1.08857 | 8.86 | 17.71 | 26.57 | 35.43 | 44.29 | 53.14 | 62.00 | 70.86 | 79.71 | 88.57 |
| 118 | 1.08929 | 8.93 | 17.86 | 26.79 | 35.72 | 44.65 | 53.57 | 62.50 | 71.43 | 80.36 | 89.29 |
| 119 | 1.09000 | 9.00 | 18.00 | 27.00 | 36.00 | 45.00 | 54.00 | 63.00 | 72.00 | 81.00 | 90.00 |
| 120 | 1.09066 | 9.07 | 18.13 | 27.20 | 36.26 | 45.33 | 54.40 | 63.46 | 72.53 | 81.59 | 90.66 |
| 121 | 1.09133 | 9.13 | 18.27 | 27.40 | 36.53 | 45.67 | 54.80 | 63.93 | 73.06 | 82.20 | 91.33 |
| 122 | 1.09200 | 9.20 | 18.40 | 27.60 | 36.80 | 46.00 | 55.20 | 64.40 | 73.60 | 82.80 | 92.00 |
| 123 | 1.09266 | 9.27 | 18.53 | 27.80 | 37.06 | 46.33 | 55.60 | 64.86 | 74.13 | 83.39 | 92.66 |
| 124 | 1.09333 | 9.33 | 18.67 | 28.00 | 37.33 | 46.67 | 56.00 | 65.33 | 74.66 | 84.00 | 93.33 |
| 125 | 1.09400 | 9.40 | 18.80 | 28.20 | 37.60 | 47.00 | 56.40 | 65.80 | 75.20 | 84.60 | 94.00 |
| 126 | 1.09466 | 9.47 | 18.93 | 28.40 | 37.86 | 47.33 | 56.80 | 66.26 | 75.73 | 85.20 | 94.66 |
| 127 | 1.09533 | 9.53 | 19.07 | 28.60 | 38.13 | 47.67 | 57.20 | 66.73 | 76.26 | 85.80 | 95.33 |
| 128 | 1.09600 | 9.60 | 19.20 | 28.80 | 38.40 | 48.00 | 57.60 | 67.20 | 76.80 | 86.40 | 96.00 |
| 129 | 1.09666 | 9.67 | 19.33 | 29.00 | 38.66 | 48.33 | 58.00 | 67.66 | 77.33 | 86.99 | 96.66 |
| 130 | 1.09733 | 9.73 | 19.47 | 29.20 | 38.93 | 48.67 | 58.40 | 68.13 | 77.86 | 87.60 | 97.33 |
| 131 | 1.09800 | 9.80 | 19.60 | 29.40 | 39.20 | 49.00 | 58.80 | 68.60 | 78.40 | 88.20 | 98.00 |
| 132 | 1.09866 | 9.87 | 19.73 | 29.60 | 39.46 | 49.33 | 59.20 | 69.06 | 78.93 | 88.79 | 98.66 |
| 133 | 1.09933 | 9.93 | 19.87 | 29.80 | 39.73 | 49.67 | 59.60 | 69.53 | 79.46 | 89.40 | 99.33 |
| 134 | 1.10000 | 10.00 | 20.00 | 30.00 | 40.00 | 50.00 | 60.00 | 70.00 | 80.00 | 90.00 | 100.00 |
| 135 | 1.10066 | 10.07 | 20.13 | 30.20 | 40.26 | 50.33 | 60.40 | 70.46 | 80.53 | 90.59 | 100.66 |
| 136 | 1.10133 | 10.13 | 20.27 | 30.40 | 40.53 | 50.67 | 60.80 | 70.93 | 81.06 | 91.20 | 101.33 |
| 137 | 1.10200 | 10.20 | 20.40 | 30.60 | 40.80 | 51.00 | 61.20 | 71.40 | 81.60 | 91.80 | 102.00 |
| 138 | 1.10266 | 10.27 | 20.53 | 30.80 | 41.06 | 51.33 | 61.60 | 71.86 | 82.13 | 92.39 | 102.66 |
| 139 | 1.10333 | 10.33 | 20.67 | 31.00 | 41.33 | 51.67 | 62.00 | 72.33 | 82.66 | 93.00 | 103.33 |
| 140 | 1.10400 | 10.40 | 20.80 | 31.20 | 41.60 | 52.00 | 62.40 | 72.80 | 83.20 | 93.60 | 104.00 |
| 141 | 1.10466 | 10.47 | 20.93 | 31.40 | 41.86 | 52.33 | 62.80 | 73.26 | 83.73 | 94.19 | 104.66 |

# Next Steps in Using Gas Turbines

***Laying aside for the moment the many long-term possibilities of direct-fired combustion turbines, J T Rettaliata, Allis-Chalmers, dwells briefly on immediate applications of machines that have already been developed***

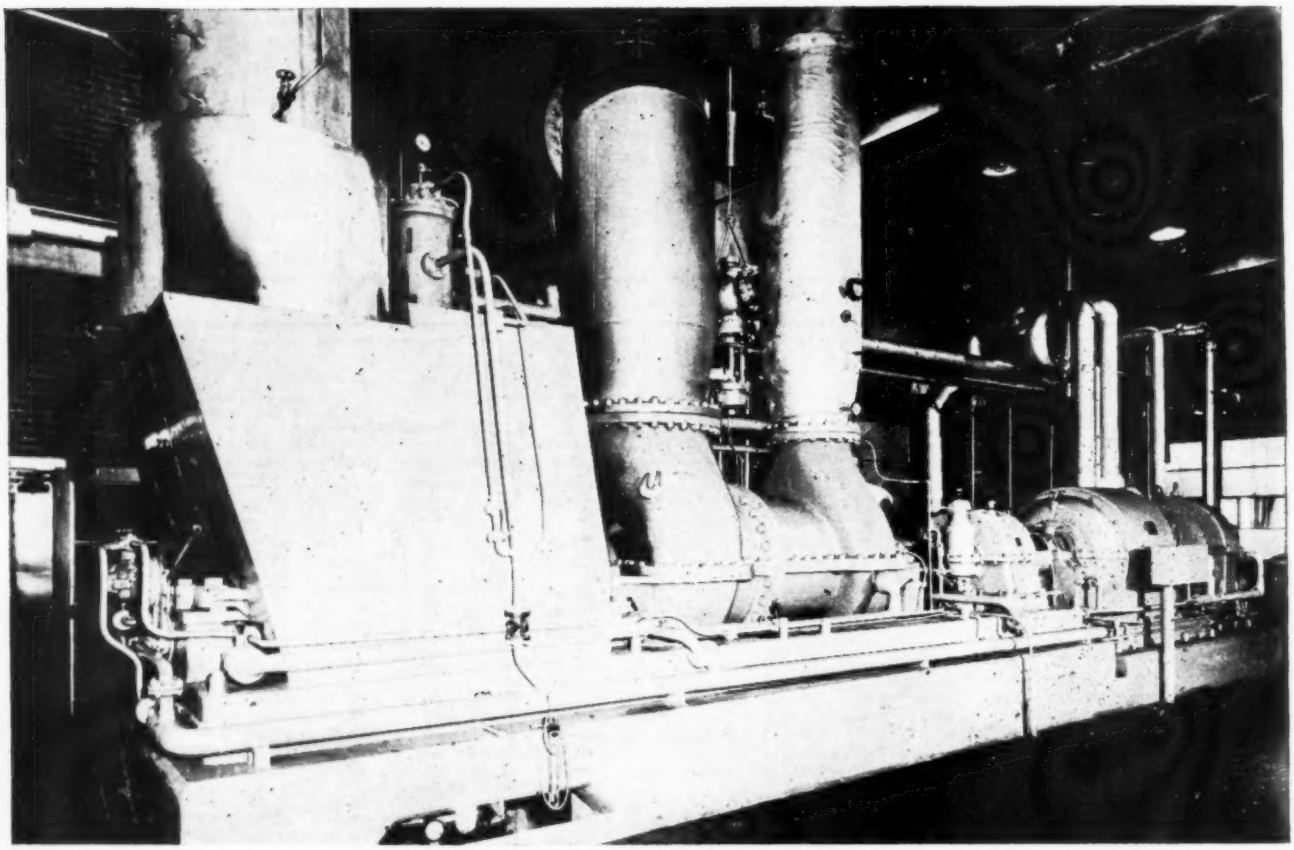


**Fig. 1—Experience with gas-turbine units in Houdry high-octane gasoline refineries has laid foundation for power units**

► WHILE THE PRESENT DAY basic gas turbine cycle is one of relatively low efficiency, it can be modified to produce good over-all thermal efficiencies with gas temperatures within the realm of attainment when employing available materials.

One version of such a revised cycle embodying regeneration, reheating and intercooling is shown in Fig. 2. In this arrangement air from the atmosphere enters the compressor where its pressure is increased to an intermediate value. It is then withdrawn and passed through an intercooler, lowering its temperature and specific volume. The cooled air traverses the high-pressure element of the compressor where it attains final pressure.

The discharged air is preheated in a heat exchanger by the exhaust gas from the low-pressure turbine, and is then further heated to a satisfactory turbine inlet temperature by injection of fuel in a high-pressure combustion chamber. Expansion of this high-temperature gas in a turbine furnishes the necessary power to drive the compressor. Back pressure on the compressor turbine is higher than atmospheric and its value is established by the energy required per pound of expanding gas to effect compression.

The gas leaving the high-pressure turbine is reheated to the turbine inlet temperature and then expanded in a low-pressure turbine to furnish the useful power of the cycle. As mentioned, the exhaust gas from the power turbine in traversing the heat exchanger preheats the air leaving the compressor and is then discharged to atmosphere.

In addition to reducing power required for compression, the intercooler also lowers the temperature of air leaving the compressor thus making the heat exchanger more effective.

When the type of cycle just described is operated with a turbine inlet temperature of 1200 F, a compressor pressure ratio of five, and surfaces in the heat exchanger of 5000 and 1500 sq ft, respectively, a thermal efficiency at the turbine coupling of 30% is obtainable. Such an efficiency is equivalent to or even better than that achieved in most marine steam installations and small land steam power plants.

Besides having favorable efficiencies, the cycle shown in Fig. 2 also possesses attractive potentialities for marine applications. Due to the small number of pieces of equipment involved and the

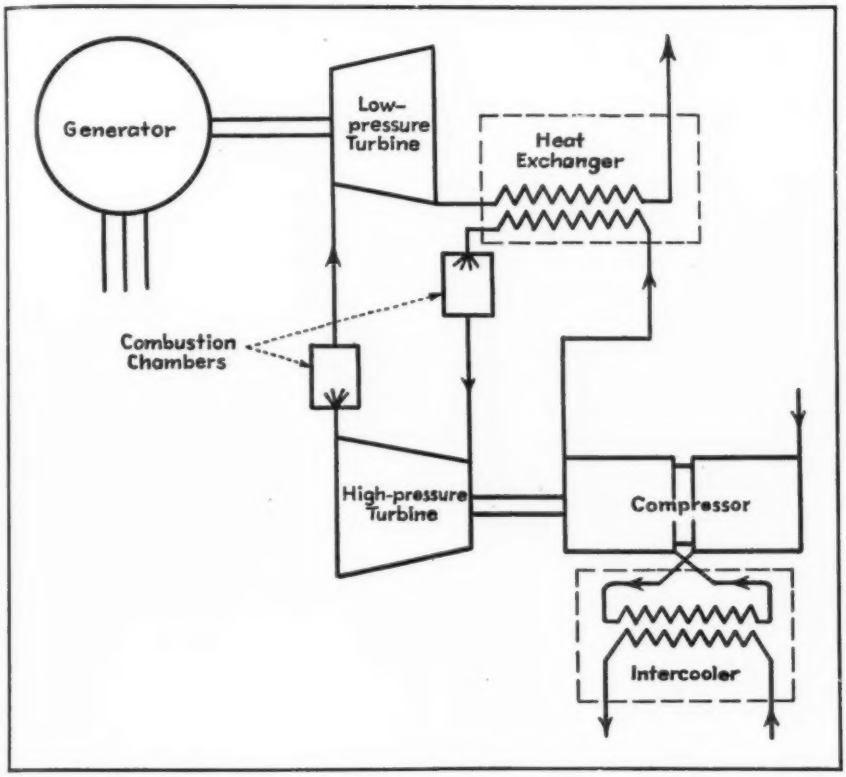



Fig. 2—One version of the gas-turbine regenerative cycle with reheating and intercooling. High-pressure turbine running at most efficient speed drives the compressor, low-pressure element provides useful power to generator or shaft

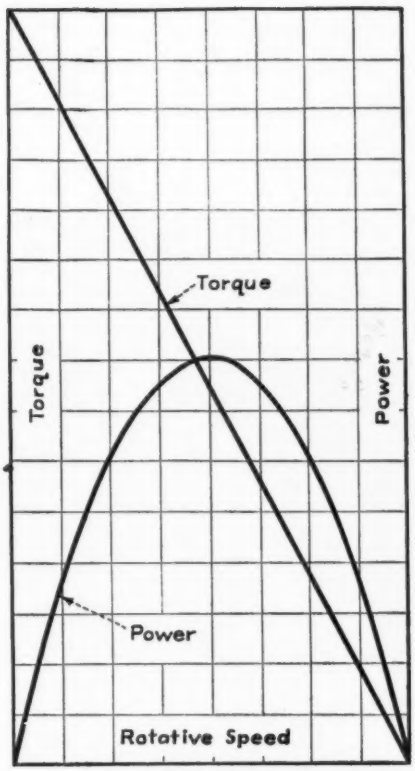



Fig. 3—Starting torque of Fig. 2 turbine is twice that at maximum power output—desirable for marine application

limited auxiliaries necessary, the space requirements can be maintained at a minimum. For cargo vessels the weight is expected to be in the range of 30 to 35 lb per shp. For combatant ships there are possibilities of further reduction by special design.

Of additional importance is the beneficial torque characteristic possible with the cycle of Fig. 2. With this arrangement the torque of the power turbine at maximum gas flow will be the same at corresponding speeds as that of a steam turbine of equal capacity at full throttle. The variation of torque and power with rotative speed is shown in Fig. 3, where it is indicated that the power curve is a parabolic function of speed, an assumption that checks closely with actual tests. In reality such an assumption is conservative, as full throttle turbine tests show a power characteristic at either side of the peak slightly in excess of the parabolic relationship, due to the effect of carryover energy in the turbine blading stages.

Using the parabolic power curve for illustration purposes the resulting torque variation will be as indicated by the straight torque line of Fig. 3. It can be seen that the starting torque will be twice that existing at the maximum power ordinate, a characteristic of turbines not generally appreciated. The carryover effect in the turbine will result in an actual starting torque in excess of twice that at maximum power.

In order to realize the torque characteristics depicted in Fig. 3 the compressor turbine is operated at full temperature and speed resulting in maxi-

(*Continued on page* 194)

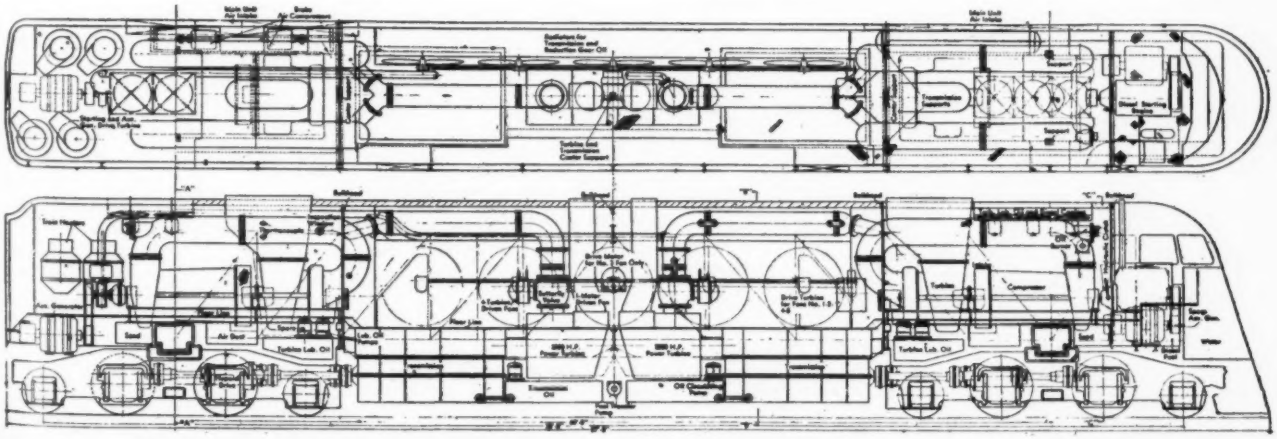


Fig. 4—A 5,000-hp 120-mph gas-turbine locomotive has two power units set fore and aft each connected to the drivers through a hydro-mechanical transmission for high tractive effort at low speeds

# THE OLD CHIEF

## WET COAL

*An insult to the intelligence of any right-thinking man*

***Too much moisture in the coal results in an excursion into mathematics with the thoughts of hard-working engineers turning to oil fuel mixed with a little cologne and the price of whiskey. Another in the series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario***

*Breathes there a man with coal so wet*
*That never to himself has bet*
*He'd shoot that gol darn dealer*

IF, in the course of events, anyone should be interested in the origin and pronunciation of half the adjectives that are not to be found in the dictionary, I would advise him to visit a boiler room where the stokers are OLD, the rating HIGH and the *COAL WET*. Once there, amid the banging of wooden mallets against chutes, the poking of hoppers and the failure of breaker pins, he would uncover a colorful and beautiful flow of language seldom to be found elsewhere.

Unfortunately, the coal that price and circumstances forced us to use in the Old Plant was one of those strip-mined types with the ability "to have and to hold" every particle of moisture that comes near or by them. Coupled with this, our bunker space had only a two-day capacity when we were on high rating. As our load increased, it became more and more difficult to maintain the pressure line but by far the most important and serious objection was the poisonous smoke that belched forth from the stoker housing whenever the wet coal stuck in the chutes or bridged in the hoppers.

### *How Much Moisture?*

Delivery was made by trucks from the dealers' docks. We would take samples of every delivery during the wet season. These we would carefully weigh on the lab scales and place in cloth-covered pans to determine the moisture content.

I recall an interesting period during which the Old Chief battled the local dealers in a vain effort to secure a rebate for the dead weight of the moisture *paid for*, over the moisture specified in their original quotations. Some kind of settlement was made for a few years but after that the contracts were on an "as is" basis.

By the way, the formula to determine the heat loss due to the moisture was:

Loss in Btu per lb of dry coal =
$M\,[212 - t + 970.4 + 0.47\,(T - 212)]$
where
$M$ = Lb of moisture per lb of dry coal
$t$ = Room temperature
$T$ = Temperature of flue gas
970.4 = Latent heat of evaporation F&A 212 F.
0.47 = Mean specific heat of superheated steam

One morning I came across Red Hogan armed with a stub of chalk making involved calculations on the bunker wall. I tried to follow his excursion into mathematics for some time but I became lost in the maze. At last after many alterations and corrections he came forth with the amazing statement that the dirty black liquid we received with the coal was *costing the owners just seven cents per gallon less than the current price of bourbon whiskey* which, as Red put it, was an insult to the intelligence of any right-thinking man, never mind a hard-working engineer.

Increasing our covered storage would have solved our problem but, owing to our hemmed-in location this would have involved an extensive conveyor installation, so naturally our thoughts ran to oil.

Knowing that the Old Chief had considerable experience with oil fuel in marine work, we looked longingly for some indication that our dreams might come true. We visualized a world that would be free from ashes, grime, coal dust and smoke backs. We pictured ourselves in white duck suits and high collars, delicately adjusting the nozzles with lily-white hands.

At last it came. The huge tanks, the heaters, the new boiler front, but this time by way of an experiment only one boiler. We soon discovered that coal dust in the same room with oil fuel did not make for that spotless cleanliness we had pictured, and definitely made us forego wearing white suits.

Red Hogan's reactions were interesting. He stated that for years his wife had complained that he smelled like a brewery.

"Now she claims that I smell like a dirty kerosene lamp. I told her," he added, "that I was going to ask the Old Chief to mix a little 'ode de colonde' with the oil fuel to make me smell nice."

# Large Boiler Goes Places with 13 to 1 Steaming Range at High Efficiency

***With an eye to future steam and power needs, Wyomissing Industries replaced seven old boilers with a pulverized-coal-fired unit rated 100,000 lb per hr, 700 psi and 700 F, now operated at 150 psi and 450 F at 86% average efficiency***

By J H ROHRER, *Day & Zimmermann Inc*

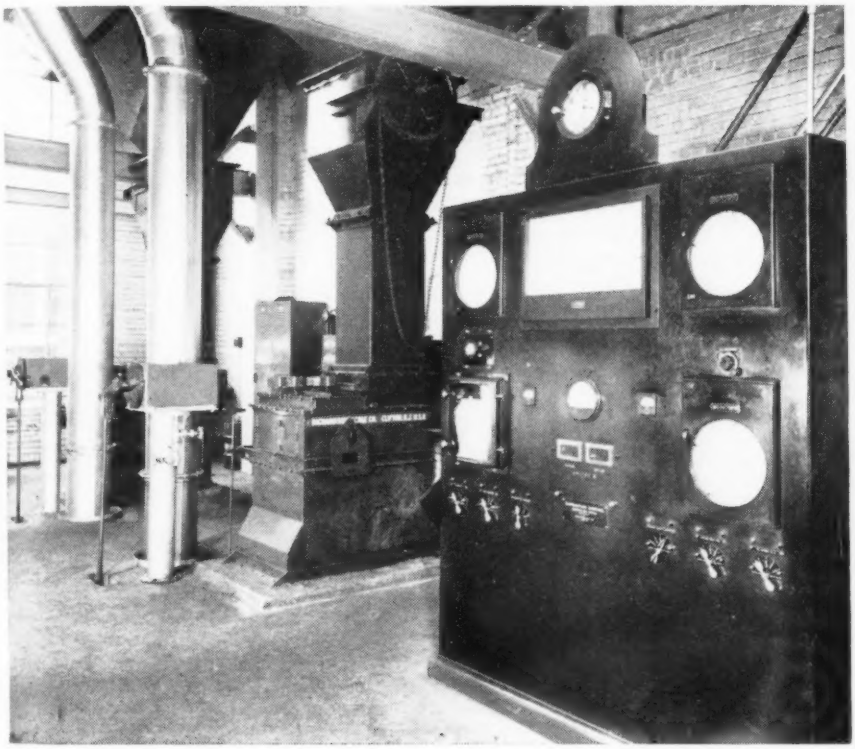


**Fig. 1—Meter and control panel, combustion-control units and all auxiliary equipment except coal pulverizers are conveniently located on the boiler-operating floor**

▶RECENTLY WYOMISSING INDUSTRIES, West Reading, Pa., modernized its boiler plant by installing one large boiler, equipped for a wide steaming range at high efficiency. This boiler, with sufficient capacity to supply the entire load, replaces seven old ones, five of which remain in standby service. With an eye to the future, the boiler has been designed for high pressure and temperature, but operates now at 150 psi, burning pulverized coal in combination coal-and-oil burners.

The company's many manufacturing units extend almost a mile and house 40,000,000 cu ft of building space. They cover one of the most extensive concentrations of industries of their kind, including textile-machine manufacturing plants; iron, steel and non-ferrous-metal foundries; knitting mills, dye houses and narrow fabric mills.

The old boiler plant, which supplied steam at 150 psi for building and process heating and for air-compressor operation, was out dated even though five of the seven boilers had been modernized by equipping them with stokers about twelve years ago. Condition of the boilers was such that their operating pressure might have had to be reduced. Also, a possible boiler failure during the winter peak load might have curtailed operation of manufacturing units. Accordingly, late in 1939 Wyomissing Industries retained Day & Zimmermann, Inc, plant designers and constructors, to make a study of steam and power requirements to correct these conditions. This work was done under the direction of the owner's engineering staff, headed by J P Freund.

As in most such cases, the problems resolved themselves into: (1) determining whether to generate power eventually, (2) selecting the most suitable fuel and the best firing method, (3) selecting number of steam-generator units for the manufacturing plant's total requirements. Here's how we dealt with the three conditions:

1. *Determining whether to generate power eventually.* Heating and process steam approximated 100,000 lb per hr in cold weather, 15,000 to 30,000 lb per hr in summer during working hours, and as low as 3000 lb per hr during summer nights and shutdowns. Electric load varied during work periods from 5400 kw in winter and 3000 kw in summer to 200 kw or lower during summer nights and holidays. All electric power was purchased.

### *Heating and Power*

Heating and power loads did not synchronize entirely because steam load is mainly heating. To determine the amount of power that could be generated if the heating and process steam were supplied by expanding steam at 700 psi down to 90 psi for distribution to the existing heating mains, we made an hour-by-hour analysis for every day of a typical year. We then calculated the steam required to generate the power not produced by heating steam. This analysis showed that the net saving in operating cost would be about $117,000 per year if all power were generated at the plant. Another possibility favoring high pressure was that some high-pressure steam might be required directly in future in the operation of new processes.

Frequently it is assumed that pro-

(*Continued on page* 98)

# Consistent development of Riley Pulverizers

## *Before purchasing pulverizers these important operating characteristics*

Pulverizers should be purchased on the basis of the proper evaluation of each of the many following operating characteristics—not on the basis of any one characteristic.

### FLEXIBILITY—WIDE LOAD RANGE

Because a change in rate of coal feed gives an instantaneous change in coal output and because a comparatively small amount of primary air is required for proper pulverizer performance, widely fluctuating loads are easily carried. Load ranges greater than 10 to 1 are carried satisfactorily at many Riley installations.

### SUSTAINED FINENESS OF PULVERIZATION

Due to recent developments wear of the various pulverizing elements has a balancing effect upon fineness of pulverization with the result that fineness is maintained throughout the life of the pulverizing elements. Fineness readings plotted against tonnage pulverized gives a straight line curve. No adjustment to pulverizer is required as parts wear.

### MAINTENANCE

Changes in design and materials utilized has resulted in increase in life of pulverizer parts. This means greater continuity of operation.

### EASE OF PART REPLACEMENTS

It is easy and simple to make part replacements, requiring but short outage for repairs. Complete overhaul of a 24,000 lbs. per hour Riley Pulverizer can be made within seven to eight hours.

### EASE OF LUBRICATION—BEARING LOCATION

All bearings used with Riley Pulverizers are located outside and independent of the pulverizer housing where they are readily accessible. Oiling is required but once daily. There are no seals that require grease from pressure guns.

### EXPLOSION HAZARD

There has never been an explosion in a Riley Pulverizer. Because of design features there can be no explosion in a Riley Pulverizer.

### POWER CONSUMPTION

Recent developments have materially reduced the power consumption of Riley Pulverizers at maximum loads. The power consumption of Riley Pulverizers at low loads has always been low because of low no load power.

### FINENESS OF PULVERIZATION

Changes in design have brought about increased fineness without increase in power consumption, very high percentage, over 99%, of the total coal passing through a 50 mesh screen.

### EASE OF CONTROL AND OPERATION

Only secondary air and coal feed need be varied to meet load variations. No other adjustments are necessary. This greatly simplifies operation and application of combustion control.

### RELIABILITY

The more rugged construction of the new Riley Pulverizer assures even greater reliability. Plant after plant has operated Riley Pulverizers for years without outages because of mill performance. The speed with which repairs can be made also increases operating availability.

### COST OF INSTALLATION—SPACE REQUIRED

The design of Riley Pulverizers is very compact, requiring comparatively small space for installation. Due to vibrationless operation massive extensive foundations are not required.

### ABILITY TO CARRY LOW LOAD

Because pulverization is satisfactory when only about ten per cent of the air required for combustion is supplied as primary air, low loads can be carried with Riley Pulverizers.

### LIMIT OF PREHEATED AIR TEMPERATURES

Preheated air regardless of temperature can be used without tempering. There is no necessity for reducing air temperatures as a precaution against explosion or fire. Air temperatures above 600 degrees can and are being used with entirely satisfactory results.

### QUIET VIBRATIONLESS OPERATION

It is generally conceded and recognized that the Riley Pulverizer is the most quiet pulverizer manufactured—you merely hear the hum of the pulverizer motor. At all loads, including low loads or no load, Riley Pulverizers give quiet vibrationless operation.

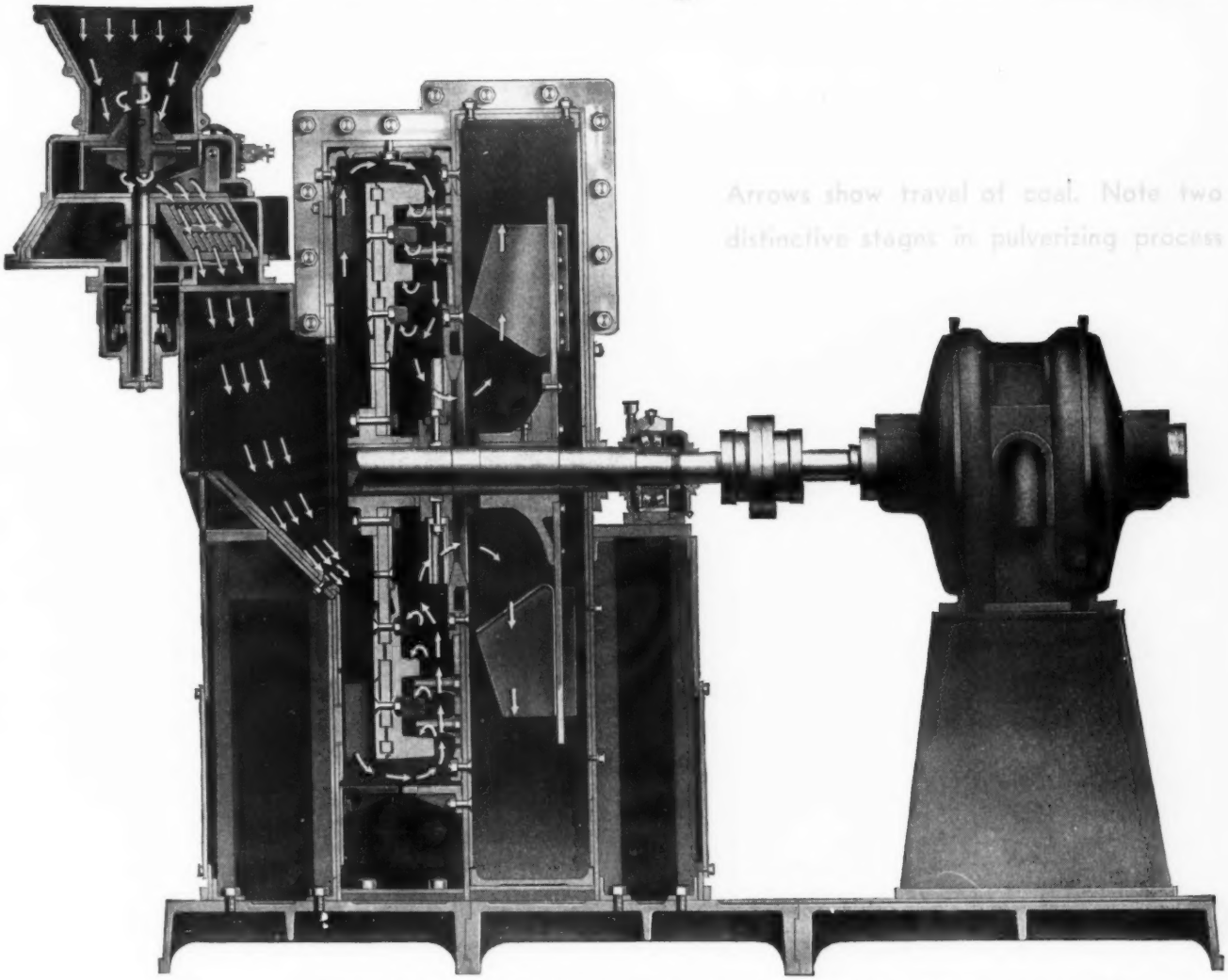
# RILEY

**STOKER CORPORATION, WORCESTER, MASS.**

Boston New York Philadelphia Pittsburgh Baltimore Buffalo Cleveland Detroit Chicago St. Louis Cincinnati St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis Richmond

It will pay you to visit modern Riley Installations

# has resulted in vastly improved Performance



## CROSS SECTIONAL VIEW IMPROVED RILEY PULVERIZERS

*Union Electric Co. of Illinois, Cahokia
*Union Electric Co. of Illinois, Venice
*Union Electric Co. of Missouri, Ashley Street
*Iowa Illinois Gas & Electric Co.
Potomac Electric Power Co.
*Interstate Power Co.
United Electric Illuminating Co.
Hartford Electric Light Co.
Connecticut Power Co.
Edison Electric Illuminating Co.
Lowell Electric Light Co.
Lynn Gas & Electric Co.
*Union Public Service Co.
Carolina Power & Light Co.
*Central Ohio Light & Power Co.
*Oklahoma Gas & Electric Co.
Pennsylvania Edison Co.
*Tenn. Valley Authority
General Electric Co.
Winchester Repeating Arms Co.
Scovill Manufacturing Co.
*Western Cartridge Co.
*Shell Oil Co.
*Standard Oil Co. of Indiana
*Curtiss-Wright Corp.
Celanese Corp. of America
Norton Company
*Kellogg Company
Dow Magnesium Co.
*American Car & Foundry Co.
Standard Oil Co. of N. J.
Worthington Pump & Machinery Co.
Titanium Pigment Co.
Agfa Ansco Corp.
Beechnut Packing Co.
Taylor Instrument Co.
National Cash Register Co.
General Machinery Co.
*Owens Illinois Glass Co.
Carnegie Illinois Steel Co.
Wheeling Steel Co.
Publicker Comm. Alcohol Co.
W. Va. Pulp & Paper Co.
Johns-Manville Co.
Carbide & Carbon Chemical Co.
American Viscose Co.
*Allis-Chalmers Manufacturing Co.
Henry Disston & Sons Co.
Champion Coated Paper Co.
Forstmann Woolen Co.
*City of Springfield, Ill.

*These plants burn mid-western coals.

*A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs*

## COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

## Large Boiler Goes Places at High Efficiency

(*Continued from page 95*)

vision for future high-pressure steam-power generation requires a large initial investment compared to cost of low-pressure steam for heating and process only. This, however, is not true because in the initial installation only the high-pressure parts of the steam generator, such as drums, headers and tubes, need be built for high pressure. In this case, the extra cost for a 100,000-lb-per-hr capacity high-efficiency steam generator, built for 700-psi as compared to 150-psi pressure, was only about $6000. Cost of installing the first steam-generating unit, complete with auxiliaries, building, piping and other equipment, was about $200,000. An extra $6000 for the high-pressure steam generator was a very small proportion of the entire cost. Therefore, a steam-generator unit for 700 psi was installed to operate at 150 psi and 80 F superheat until such time as power might be generated. Space has been provided in the boiler and superheater header connections to install a superheater for 700 F total temperature, by adding superheater tube loops if the boiler goes to high-pressure operation in the future. Future rates for purchased power may decrease and thus reduce the savings possible by operating the boiler at high pressure and generating power.

2. *Fuel selection and firing method:* As fuel for the new boiler, we considered several different possibilities:

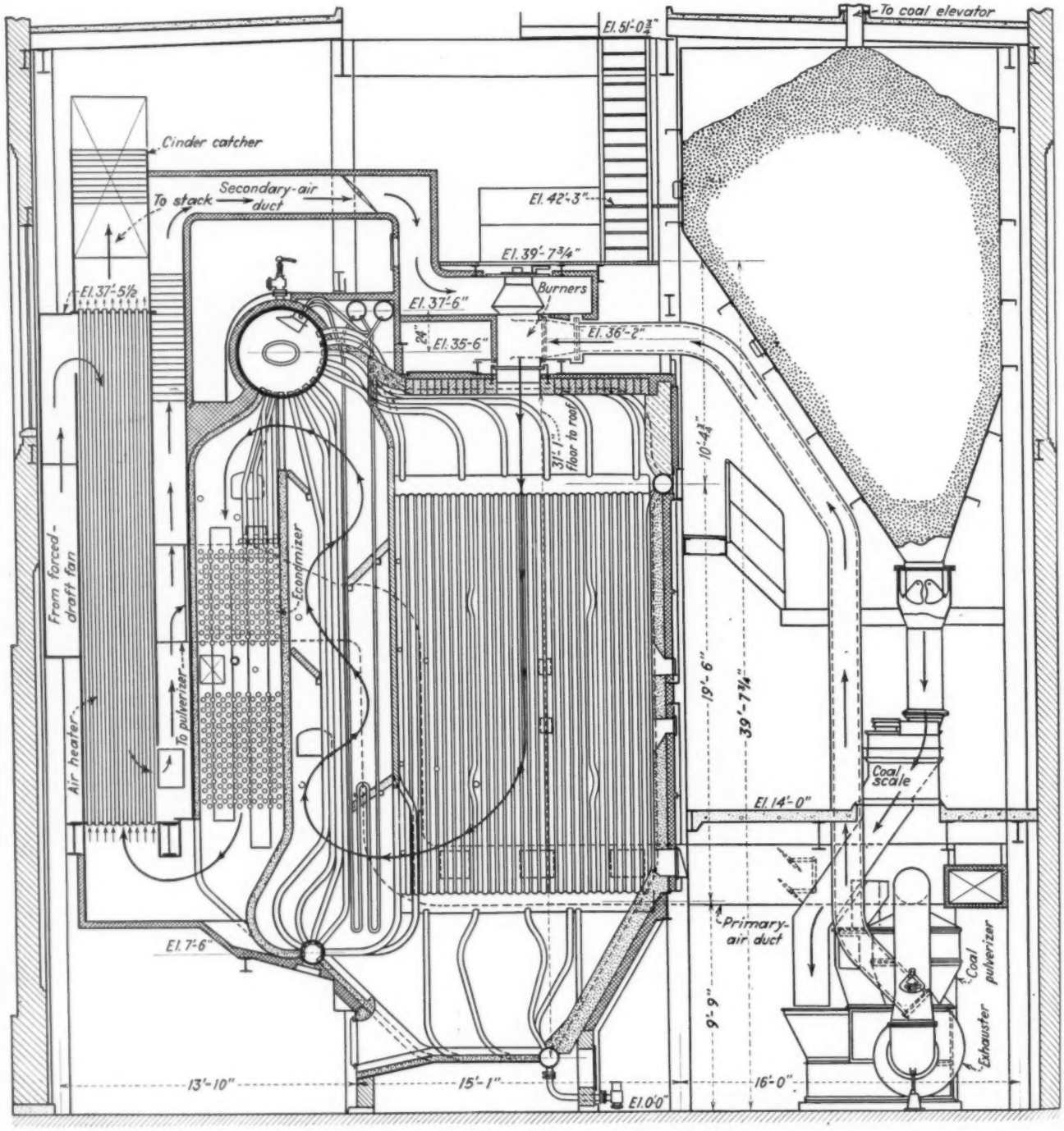



**Fig. 2—Boiler rated 100,000 lb of steam per hr has 9800 sq ft of water-heating surface divided; boiler 3490, waterwalls 2660, superheater 760 and economizer 2890 sq ft. Tubular air heater has 12,600 sq ft of heating surface**

*a. Pulverized bituminous coal*
*b. Underfeed - stoker - fired bituminous coal*
*c. Small-sized anthracite burned on chain-grate stokers*
*d. Oil*

There was little choice in cost among the first three fuels. Oil, on the other hand, was too expensive except for emergency operation, for which we decided to use it. We ruled out small-sized anthracite, even though its steam cost was about equal to bituminous coal, since the large furnace arch necessary to ignite anthracite fines would interfere with emergency oil burning. Because of wide variation in loads and exceptional low-load periods in summer, we decided in favor of pulverized-bituminous-coal firing with burners fitted for either oil or coal.

*3. Selecting number of steam-generator units:* Maximum steam load, which comes in the morning when the dye house starts, was determined to be 100,000 lb per hr on cold mornings and on mild winter days to drop as low as 50,000 lb per hr. We compared first cost and general arrangement of two 100,000-lb boilers for the complete plant to three 60,000-lb units. The three smaller ones cost about $70,000 more, not including cost of extra space.

One smaller unit when carrying the low summer loads would operate at a higher rating than would one 100,000-lb unit. However, most of the year daily load variations range from below to above the capacity of a 60,000-lb unit, so that a second unit would have to be maintained hot to take the peaks. A properly fitted 100,000-lb unit would operate efficiently over a wide range and also be satisfactory and stable at low loads.

We, therefore, decided upon a unit having a normal continuous steaming capacity of 100,000 lb per hr at about 85% efficiency as the first modernization step. Since installation, the unit has supplied up to 125,000 lb per hr during cold spells because more building space has been added since we made our studies.

### *Boilers and Coal Pulverizers*

In the old boiler plant there were five 3000-sq-ft straight-tube watertube B & W boilers, fired by single-feed retort underfeed stokers, and two 2000-sq-ft locomotive hand-fired boilers. To provide space for the new boiler, we removed the two 2000-sq-ft boilers. This space was wide enough to allow for the forced- and induced-draft fans on the operating floor at the side of this boiler. The new operating floor, 14 ft above ground-floor level, carries all control equipment, fans, coal scales and instrument panel. Two pulverizers on the ground floor have all their controls on the operating floor. This places all controls and fans and the emergency hand control of feedwater so that the operator has them under continuous observation, within convenient reach on the operating floor.

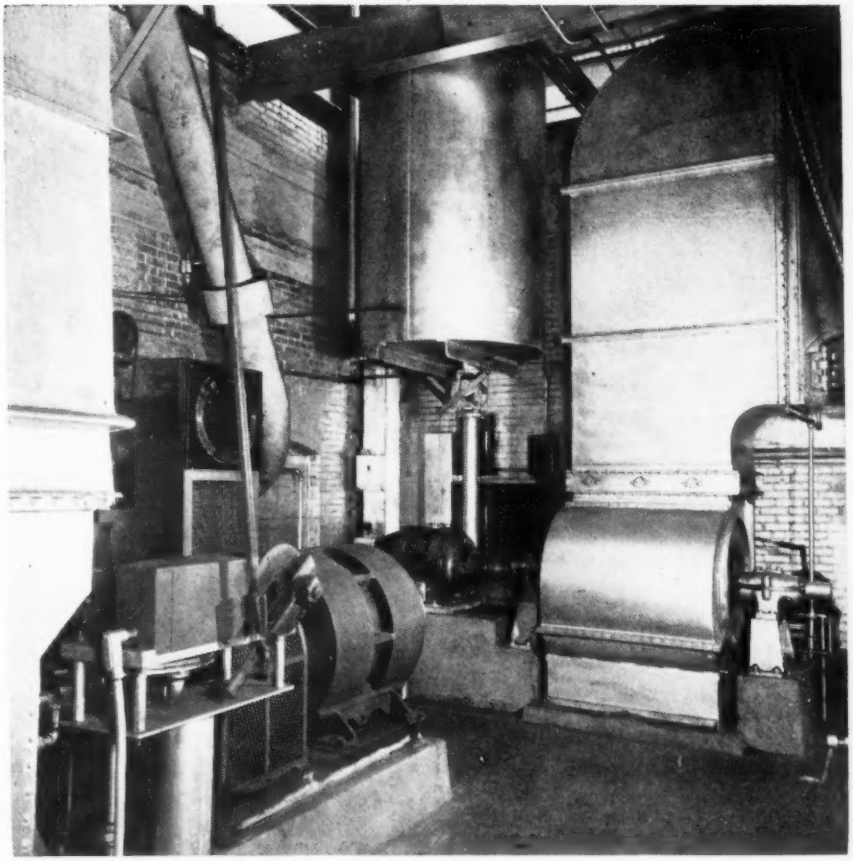


**Fig. 3—Forced-draft fan, right background, driven direct by wound-rotor motor and induced-draft fan, left foreground, powered by a synchronous motor through variable-speed magnetic drive to obtain wide range of operating speed**

The steam-generating unit consists of a single-drum boiler, economizer, air heater, superheater and complete water-cooled furnace, Fig. 2. Heating-surface proportions—boiler 3490 sq ft and economizer 2890 sq ft—are somewhat unusual for industrial plants. Water temperature leaving the economizer is not much below steam temperature, which insures even steaming and provides a reservoir of hot water ready to enter the boiler to handle sudden load increases.

The horizontal-tube upward-counterflow economizer discharges through multiple connecting tubes to the steam drum under the working water level. Vertical-tubular air heater has zoned passes for uniform air distribution, and is steel-plate cased with welded joints.

Furnace walls have a refractory lining back of the waterwall tubes and are insulated with high-temperature insulating blocks and magnesia blocks. Steel plate, continuously welded to structural supports, incloses the furnace setting.

Two pulverized-coal burners in the top of the furnace, Fig. 2, fire downward. Gas leaving the furnace enters the boiler near its bottom. Each burner has a light-oil ignition system consisting of a light-oil torch in the burner, lighted by an electric spark, control of oil and electric ignition being on the operating floor, Fig. 4. Louver air-shutoff dampers on the burners are controlled also from the operating floor by a system of shafts and chains. This put complete control of the burners within convenient reach of the operator on the operating floor. Two pulverizers, each with sufficient capacity to carry 75% of full boiler load, are connected one to each burner with no cross-connections.

### *Auxiliary Equipment*

All controls of auxiliary equipment are on the operating floor. The induced-draft fan connects to an 80% power-factor synchronous motor through a variable-speed magnetic drive rated 100 hp, with a speed range of 1150 to 150

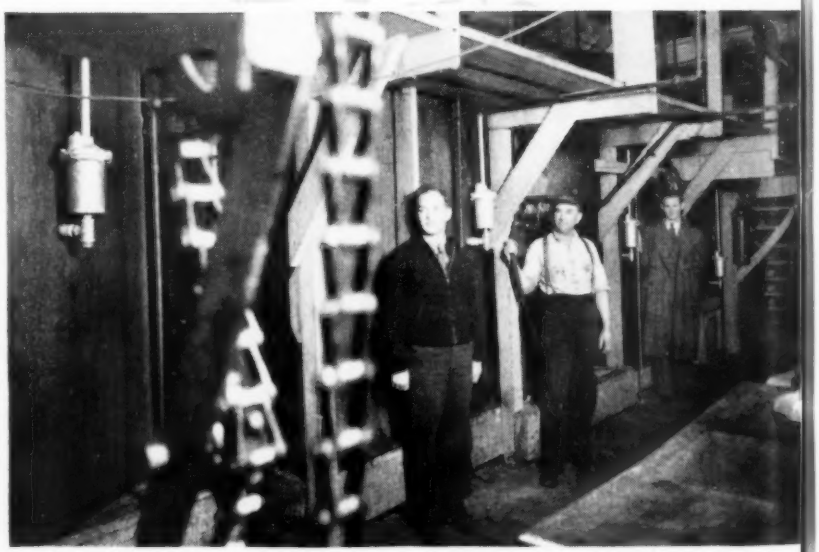
(*Continued on page* 102)

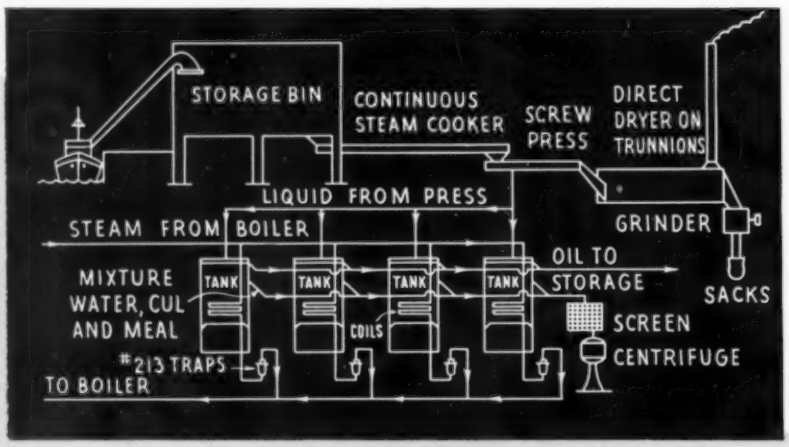
# $625.00 return from $20.75 trap

## *Fuel Saving* $250 a season with Armstrongs

**FILE 2-41** — Typical of the job Armstrong inverted-bucket steam traps are doing in the food industry and others in saving fuel, money, heating time, maintenance and manpower, is the experience of British Columbia Packers, Vancouver, B. C.

This company not only cans salmon, clams, oysters, pritchards and herring, but also handles the fish waste to convert it to valuable oils and meal for stock and poultry feed. Waste flows from storage by gravity to a continuous cooker where live steam is employed to do the cooking. After cooking the mass is fed into a hopper and then into a screw press, and the meal cake passed onto the dryer. Oil and water from the press pass into steam heated settling tanks. Prior to installation of No. 213 Armstrong Traps for draining these coils, the condensate was blown off to the atmosphere through cracked valves, wasting the heat of the condensate and providing only partial drainage from the coils.





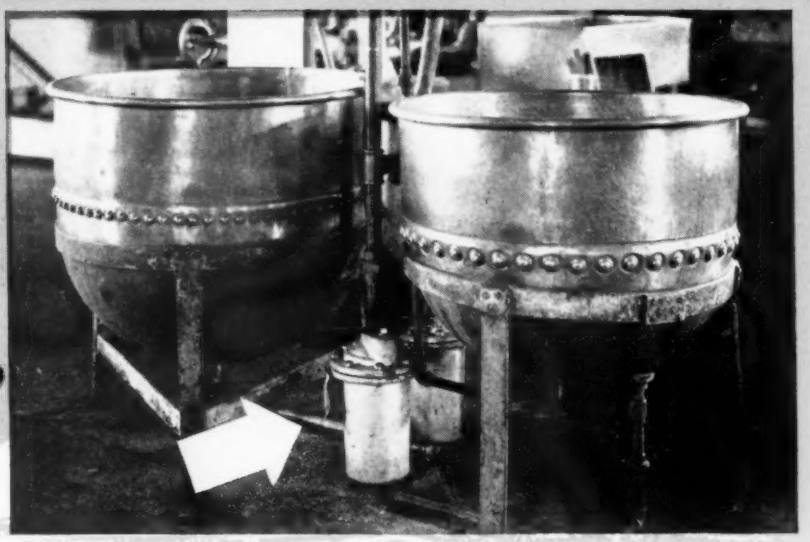

With Armstrong trapping, the coils stay hotter with a resultant saving of twelve gallons of oil per hour. With four traps, the savings in fuel are about $250.00 per season, which over a conservative ten-year period figures to a return of $625.00 for an investment of $20.75 for each trap! The drawing represents a flow-sheet of the reduction plant.

### Other Savings Reports

Other examples of savings in food industries with Armstrong Traps: canning plant speeds up cooking kettles 30% . . . Packing company saves $35 a year with smallest trap . . . Traps pay for themselves in 30 days, on water heaters . . . Traps on stills save $25 a day on fuel.

**CUTS COOKING TIME 30%**

*Individual Armstrong traps with automatic air bypasses cut by 30% the time required to bring these 240 gallon jacketed ketiles to a boil.*

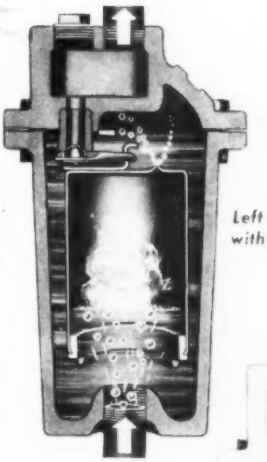


# "Complete" TRAPPING WITH ARMSTRONGS works wonders in all industries

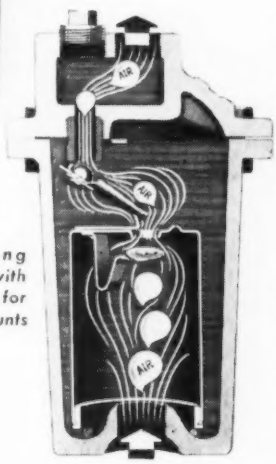
The amazing results secured by Armstrong traps in all industries is due to the Armstrong principle of "complete" trapping, both in the trap itself and in the method of installation.

Cracking a valve drains condensate but wastes steam. (A 1/16" orifice at 100 psi. wastes 13,200 lbs. of steam a month). Devices actuated by liquid level cannot draw off air. (½ of 1% by volume of air mixed with steam can cause a reduction in heat transfer efficiency of 50% according to one authority.) Heat actuated devices have to hold the condensate back until it cools below steam temperature to prevent loss of steam, therefore air has a hard time getting out. Continuous flow devices either obtain poor drainage at heavy loads, or use larger openings and lose steam on light loads.

Armstrong traps insure the highest possible fuel saving and heating speed by doing a *complete* job of drainage. They not only pass condensate as fast as it forms, without leakage of steam, but also eliminate air from the system and have the ability to handle all ordinary sludge and sediment. The patented free-floating valve and other engineering features insure freedom from wire-drawing in the valve orifice, permit holding tight against vacuum, and insure long life with negligible maintenance. Considering the hot condensate capacity, Armstrong traps are very small in size and low in cost. Considerably over a million are in use. Available in straight-through, angle and vertical piping styles. Standard Armstrong Traps for all sizes and pressures, and special traps for air, water, gasoline and other services, are described and illustrated in the Armstrong Trap Book, which also contains valuable data on operation, installation and service. We'll be glad to send you a copy.



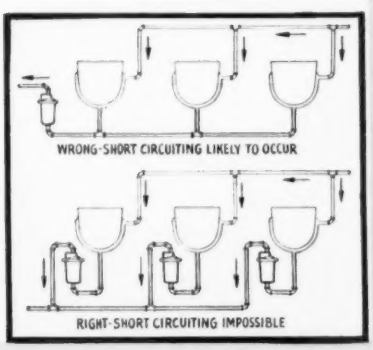
*Left — Armstrong trap with bucket in "closed" position.*




*Right — Armstrong "blast" type trap, with auxiliary air vent, for handling large amounts of air.*

**ARMSTRONG MACHINE WORKS**
812 Maple St. • Three Rivers, Mich.

"Complete" trapping also means the practice of applying a trap of proper size to each unit requiring drainage.




ARMSTRONG "INVERTED BUCKET" STEAM TRAP

# Armstrong

**STEAM TRAPS • AIR TRAPS • PURGERS • HUMIDIFIERS**

## Large Boiler Goes Places at High Efficiency (*Continued from page 99*)

rpm. Layout of this fan was arranged for automatic furnace-pressure control of a damper in the fan inlet with a follow-up on fan-speed control to hold a small differential suction across the damper. Because furnace pressure could be maintained by the automatic furnace-pressure regulator acting on the variable-speed electric drive to control fan speed, the damper is unnecessary. At times, because of low load the fan barely revolves, but direct control of its speed by the furnace-pressure regulator has proved highly satisfactory in keeping fan speed proportional to boiler load.

Automatic combustion control of the electric-eye design measures neither coal feed nor quantity of combustion air. An electric eye, shining across the gas stream leaving the boiler, measures smoke density and controls a motor operating a louver damper in the forced-draft-fan outlet.

A steam-pressure-controlled damper in the pulverized-coal pipe to the burner controls fuel feed. A slight change in steam pressure changes fuel feed proportionately, and simultaneously

(*Continued on page 168*)

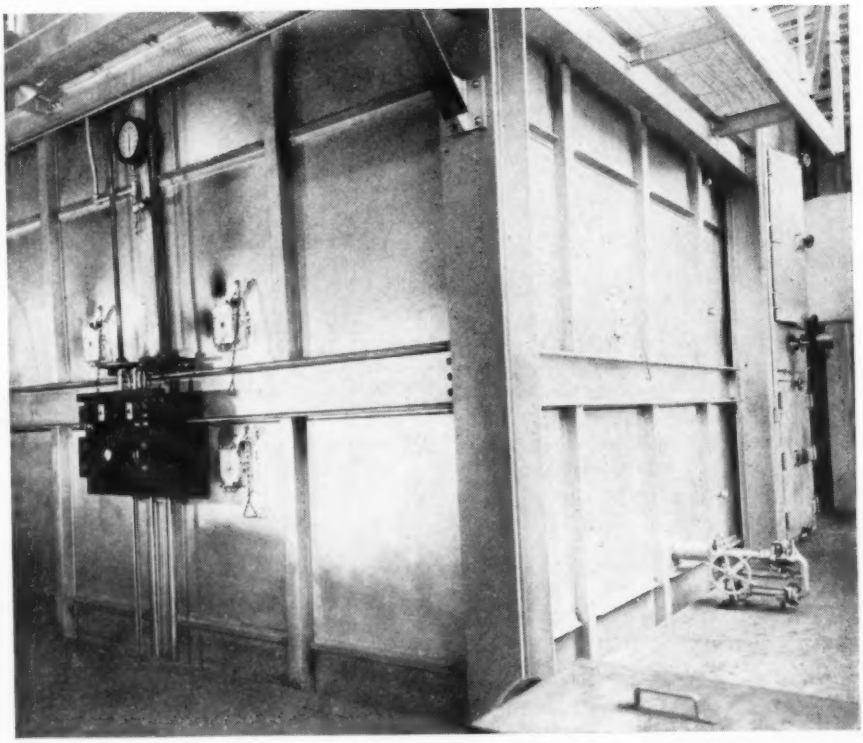


Fig. 4—Each pulverized-coal burner has a light-oil ignition system consisting of a torch lighted by an electric spark remotely controlled from a panel on the boiler front with observation ports conveniently located near panel.

# PRINCIPAL NEW BOILER-PLANT EQUIPMENT

## *Wyomissing Industries, West Reading, Pa.*

### STEAM-GENERATING EQUIPMENT:

Boiler, superheater, waterwalls, economizer, air heater and boiler settings ..... Day & Zimmermann, Inc.
***Boiler***, 1, single drum; heating surface 3490 sq ft. ***Superheater*** 760 sq ft. ***Waterwalls*** 2660 sq ft. ***Economizer*** 2890 sq ft. ***Air heater***, tubular, max air temp 400 F, 12,600 sq ft. Rated max continuous steaming capacity, 100,000 lb per hr; has operated at 125,000 lb per hr. Design conditions 700 psi and 700 F; operating conditions 150 psi and 450 F steam temp. Furnace volume 3700 cu ft; Btu liberated per cu ft per hr, 24,500 at 100,000 lb steam and 85% efficiency.
Boiler-setting heat insulation ..... Philip Carey Mfg Co
Refractory settings and baffles ..... Franklin Engineering Co

### COMBUSTION EQUIPMENT:

Automatic combustion control ..... Brooke Engineering Co
Soot blowers ..... Bayer Co
Pulverized-coal burners ..... Peabody Engineering Corp
Coal-ignition oil system ..... Peabody Engineering Corp
Coal pulverizers, 2, capacity each 7000 lb per hr .. Strong-Scott Mfg Co
Pulverizer driving motors, squirrel cage, 75 hp, 1760 rpm
General Electric Co
Pulverizer-motor starters ..... General Electric Co
Forced-draft fan, 32,000 cfm at 90 F and 10-in. static pressure with outlet-damper control ..... B F Sturtevant Co
Forced-draft-fan motor, slipring, 75 hp, 1800 rpm, 50% speed reduction ..... General Electric Co
Forced-draft-fan-motor control ..... General Electric Co
Induced-draft fan, 52,000 cfm at 375 F and 10-in. static pressure
B F Sturtevant Co
Induced-draft-fan motor, synchronous, 100 hp, 1200 rpm, 80% leading pf ..... Electric Machinery Mfg Co
Induced-draft-fan-motor starter ..... Electric Machinery Mfg Co
Induced-draft-fan variable-speed magnetic drive
Electric Machinery Mfg Co.
Ducts and breechings ..... Heilman Boiler Works
Stacks, self-supporting steel, unlined, 125 ft high, 60-in. inside diameter ..... Tippet & Wood

### COAL-AND-ASH HANDLING:

Coal bunker ..... Link-Belt Co
Bucket elevator and screw conveyors ..... Link-Belt Co
Automatic coal scales ..... Richardson Scale Co
Flyash-collecting system ..... American Blower Corp
Ash-disposal system ..... United Conveyor Co

### PIPING, VALVES AND FITTINGS:

Safety valves ..... Foster Engineering Co
Non-return valves ..... Schutte-Koerting Co
Blowdown valves ..... Cochrane Corp

### FEEDWATER SYSTEM:

Water columns ..... Diamond Power Specialty Corp
Feedwater regulator ..... Northern Equipment Co
Acid-treatment addition to existing zeolite system:
Forced-draft aerator ..... International Filter Co
Rate-of-flow controller ..... International Filter Co
Proportioning chemical pumps ..... Milton Roy Co
Feedwater supervisory service ..... W H & L D Betz

### METERS AND INSTRUMENTS:

Steam flowmeter ..... Brown Instrument Co
Pressure and temperature recorder ..... Brown Instrument Co
Boiler-water-level recorder ..... Brown Instrument Co
Draft gage, 8-point ..... Ellison Co
$CO_2$ recorder ..... Brown Instrument Co
Steam-pressure gages ..... Consolidated Ashcraft Hancock Co
Thermometers, recording ..... Brown Instrument Co

### MISCELLANEOUS:

Structural steel ..... Reading Steel Products Co
Sash ..... Detroit Steel Products Co
Roof ..... Barrett Co
General contractor ..... Day & Zimmermann, Inc

# Simplify Lubrication Problems With These Tested Buying Specifications

***A J Strohmaier, lubrication engineer, Joseph E Seagram & Sons, presents consumers' lubrication specifications, tells why and how they were developed, answers objections to buying oils and greases according to specifications and recounts how they have greatly simplified his company's lubrication problems***

**Buying lubricants on consumers' specifications establishes a basis for bidding that insures uniform-quality products at lowest cost, reduces the number of lubricants and thus simplifies their application by adopting a standardized procedure**

LUBRICATION PLAYS an important role in any industrial plant and distilleries are no exception, particularly now when they are operating on a 24-hour schedule seven days a week to keep pace with our Government's unprecedented needs for industrial alcohol.

A modern distillery is a complex organization, which usually comprises five different but integrated processing plants: power, distillery, foods and feeds, warehouses and bottling. Variations in equipment and operation confront the lubrication engineer with all degrees of bearing speeds, temperatures and loadings. Stringent sanitation requirements in regard to water complicate the situation further. To solve all these problems economically is a real task—one that it is doubtful anyone has yet done completely. However, at Joseph E Seagram & Sons, Louisville, Ky., we have developed a 2-fold attack on the problem:

1. Scheduled lubrication of all equipment (POWER, May 1943, p 81-83) has greatly simplified the work of our oilers and lubrication foremen.

2. Standard specifications, in terms of minimum number of lubricants necessary to meet our requirements, guide our purchasing department and, at the same time, enable us to maintain uniform quality regardless of the source of purchase.

We developed this second attack by (A) compiling a list of our equipment manufacturers' lubricant recommendations (B) surveying specifications of available lubricants which met these recommendations (C) developing an inventory that met our needs with a minimum number of lubricants.

Then we wrote a set of tentative specifications, eliminating oils deficient in most respects and retaining the best-suited commercial brands. We collected voluminous data as a basis for these conclusions but the task was a delicate one and whether we have been successful is perhaps a matter of individual opinion.

We sent these tentative specifications to our various plants for comment or approval, revised and sent them out again until approval slips had come from all. Meanwhile, many oil-company representatives proved most helpful in molding our specifications. For easy adaptation to subsequent changes or additions, we bound final specifications and the ASTM laboratory procedures in looseleaf books. Copies were distributed to all our employes connected with lubrication problems.

We also sent copies to oil companies, with invitations for bids and to supply us specific data on lubricants that would meet our specifications, or give a guarantee the lubricants they offered would satisfy our requirements. One-year contracts were signed on the lowest bids and the lubricants apportioned to our plants. We repeat this procedure before the expiration of each contract.

Since the first application of our lubri-

## TABLE I—CODE NUMBERS AND LUBRICANTS AND THEIR MOST IMPORTANT DUTIES

| SEAGRAM CODE NO. | PURPOSE |
|---|---|
| | **INDUSTRIAL LUBRICATING OILS** |
| Seca 1 | Deepwell centrifugal pumps, exposed to low ambient temperatures |
| Seca 2 | Turbines with the following operating characteristics: |

| | | | | |
|---|---|---|---|---|
| Speed, rpm | 3600 | 3600 | 3600 | 3600 |
| Rating, kw | 250 | 750 | 750 | 1000 |
| Inlet steam press, psi | 240 | 385 | 400 | 400 |
| Inlet steam temp., F superheat | 28 | 125 | 0 | 0 |
| Exhaust steam press, psi | .... | 90 | 90 | 12 |

| | |
|---|---|
| Seca 3 | A. Main bearing, crank, etc of horizontal steam engines utilizing either circulating or splash lubrication systems<br>B. Crankcase of steam-driven air compressors<br>C. General lubrication of sleeve and ball bearings |
| Seca 4 | A. Ring-oiled sleeve bearings or ball bearings of Wait, Westinghouse, Elliot, Terry and Sturtevant turbines<br>B. Cylinders of steam-driven air compressors<br>C. Crankcase of electrically driven Ingersoll-Rand air compressor, model 50B, type 40, 2-stage |
| Seca 5 | Ingersoll-Rand diesel engine, 460 hp, type S, 600 rpm, operating continuously |
| Seca 6 | Parallel drive reduction-gear units (Falk, Jones, Master and General Electric geared-head units) |
| Seca 7 | A. Cylinders of steam engines and steam pumps operating at pressures up to 90-psi saturated steam<br>B. Light-duty wormgear-reduction drive units |
| Seca 8 | Link-Belt PIV variable-speed reduction units |
| Seca 9 | A. Cylinders of steam engines operating at pressures up to 180-psi saturated steam<br>B. Heavy-duty wormgear-reduction drive units |
| | **INDUSTRIAL LUBRICATING GREASES** |
| Seca 100 | Calcium-base grease for sleeve bearings, normal operating conditions |
| Seca 101 | Sodium-base grease for ball or roller bearings, normal operating conditions |
| | **AUTOMOTIVE-MOTOR OILS** |
| Seca 200 | SAE 10W — Motor oil for trucks, cars, etc |
| Seca 201 | SAE 20W — " " " " " " |
| Seca 202 | SAE 30 — " " " " " " |
| Seca 203 | SAE 40 — " " " " " " |
| | **DIESEL FUEL OIL** |
| | Ingersoll Rand diesel engine, 460 hp, type S, 600 rpm, operating continuously |

cant specifications, we have noted these definite advantages:

1. We established a basis for bidding which provides us with quality lubricants at lowest cost.

2. Regardless of supply source, the lubricants we buy have definite and uniform quality. In consequence, we can increase the number of supply sources when needed, or divide orders among several suppliers without fear of different type or quality.

3. We not only reduce the number of lubricants in each plant but confusion in their application, and consequent hazards.

4. Lubricants and lubricating procedures are standardized for our various plants.

5. We simplify the duties of purchasing departments and lubrication foremen.

6. In equipment failures due to improperly refined lubricants, guarantees can be checked by standard laboratory tests.

7. We insure fairer competition among vendors by eliminating the personal and emphasizing the quality-product angle.

8. Appreciation of lubricant characteristics and quality and of machine requirements is greater among our oilers and other employes.

To date our specifications cover nine lubricating oils, one diesel-fuel oil and

## TABLE II—STANDARD SPECIFICATIONS

**ISSUED BY STANDARD SPECIFICATIONS DEPT**
**NO. 14-4 FIRST REVISION DATE, NOV. 3, 1941**

**A. Purpose**

The oil specified herein shall be used for the lubrication of:

1. Small turbines
2. Cylinders of steam-driven air compressors
3. Crankcase of electrically driven, Ingersoll Rand, Model 50B, Type 40, 2-stage air-cooled air compressor

**B. Grade**

This lubricating oil shall be of one grade only. It shall be referred to, in the invitation for bids, by our company code number "Seca 4"

**C. Material and Workmanship** — See section D

**D. Requirements**

1. Performance guarantee

The oil shall be suitable in every way for the lubrication of:

a. Ring-oiled sleeve bearings, or ball bearings, of Wait, Westing Elliott, Terry and Sturtevant turbines
b. Cylinders of steam-driven air compressors
c. Crankcase of electrically driven, Ingersoll Rand, Mod Type 40, 2-stage air-cooled air compressor

2. General

The lubricating oil shall be a pure mineral oil obtained by t tional distillation of petroleum. It shall be free of acid, sulphates, free sulphur or corrosive compounds $SO_3$ or su soap, resin, or tarry constituents

3. Detailed

| | |
|---|---|
| a. Carbon residue, % | 0. |
| b. Color (NPA) | 3. |
| c. Corrosion | N |
| d. Flashpoint, F | 4 |
| e. Neutralization number | 0. |
| f. Pour pt, F | 1 |
| g. Steam emulsion value, sec | |

## TABLE III—OIL CHARACTERISTICS REQUIRED IN LUBRICATION SPECIFICATIONS

*Tabulation of data detailed for the specifications in D-3, Table II*

| Characteristics | INDUSTRIAL LUBRICATING OILS | | | | | | | | | MOTOR OILS | | | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seca 1 | Seca 2 | Seca 3 | Seca 4 | Seca 5 | Seca 6 | Seca 7 | Seca 8 | Seca 9 | Seca 200 SAE 10W | Seca 201 SAE 20W | Seca 202 SAE 30 | Seca 203 SAE 40 | |
| Carbon resi, max... | 0.05 | 0.01 | 0.10 | 0.10 | 0.10 | 0.50 | 2.00 | 0.75 | 2.00 | 0.10 | 0.15 | 0.30 | 0.35 | ASTM, D189–41 |
| Color, NPA, max... | 3.0 | 1.5 | 3.0 | 3.0 | 5.0 | 6.0 | .... | 7.0 | .... | 3.5 | 5.0 | 5.0 | 6.0 | ASTM, D155–39T |
| Corrosion..... | None | None | None | None | None | None | None | None | None | None | None | None | None | Fed Spec Bd No. 530.31 |
| Fixed or fatty oils.. | .... | .... | .... | .... | .... | .... | 5–8% | .... | 5–8% | ..... | ..... | ..... | ..... | |
| Flash pt, F, min... | 330 | 370 | 380 | 400 | 380 | 440 | 470 | 500 | 500 | 375 | 405 | 410 | 430 | ASTM, D92–33 |
| Neutr no. max..... | 0.05 | 0.05 | 0.05 | 0.05 | 0.10 | 0.05 | 0.30 | 0.05 | 0.30 | 0.10 | 0.10 | 0.10 | 0.10 | ASTM, D188–41T |
| Pour pt, F, max.... | −20 | 25 | 30 | 10 | 0 | 5 | 30 | 10 | 20 | 0 | 0 | 10 | 10 | ASTM, D97–39 |
| Steam-emulsion value, sec, max... | .... | 30 | .... | 75 | .... | .... | .... | .... | .... | ..... | ..... | ..... | ..... | ASTM, D157–36 |
| Viscosity, SUV at 0 F, sec..... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 5,000–10,000 | 10,000–40,000 | ..... | ..... | ASTM, D341–39 |
| At 100 F, sec..... | 140–170 | 150–175 | 180–210 | 300–350 | 780 max | 900–1000 | 2250 max | 3000 max | 3200 max | ..... | ..... | ..... | ..... | ASTM, D88–38 |
| At 130 F, sec..... | .... | .... | .... | .... | .... | .... | .... | .... | .... | ..... | ..... | 185–255 | 255 min | ASTM, D88–38 |
| At 210 F, sec..... | 42 min | 43 min | 45 min | 51 min | 60 min | 81 min | 120–140 | 120–160 | 145–165 | ..... ..... | ..... ..... | ..... ..... | 75 max | ASTM, D88–38 |
| Index..... | 90 min | 90 min | 90 min | 90 min | 30 max | 90 min | 85 min | 90 min | 85 min | 90 min | 90 min | 90 min | 90 min | ASTM, D567–41 |

two greases for plant use, as well as four motor oils for automotive equipment. These lubricants cover most of our requirements, but there will always be small purchases of special lubricants for unusual conditions which cannot be covered by specifications. Table I lists our code numbers of lubricants and the most important duties they are expected to perform.

Specifications for all lubricants have been set up in standard form, Table II. They differ from each other only in the divisions headed "A. Purpose" and "D. Requirements." Table III tabulates data listed under "D3. Detailed" in the oil specifications; Table IV lists "Detailed" in the grease specifications, while Table V gives requirements in the diesel-fuel-oil specifications. Grease specifications include these additional restrictions:

*1. Performance guarantees for greases:*

Seca-100 grease shall be suitable in every way for the lubrication of sleeve bearings of motors and equipment lubricated by piston and Venango-pin grease cups and pressure grease guns.

Seca-101 grease shall be suitable in every way for lubricating ball or roller bearings on line shafts, electric motors, etc.

*2. General requirements for greases:*

A. Seca-100 grease shall be a smooth, homogeneous mixture of high-grade

## MALL-TURBINE LUBRICATING OIL

h. Viscosity (SUV) at
100 F sec..... 300–350
210 F sec..... 51 min
Index..... 90 min

2. Methods of Sampling, Inspecting and Testing

Unless otherwise specified, the lubricating oil specified herein shall be sampled, inspected and tested according to the procedure described in Section E of Standard Specification No. 14–0

3. Packaging, Packing and Marking

1. Packaging — The lubricating oil shall be packaged in the type container specified in individual orders and releases

2. Packing — Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers for safe transportation, at the lowest rate, to the point of delivery

3. Marking — Unless otherwise specified, each individual package, and its shipping container, shall be marked with the name of the material, our company code number (as defined by the contract or order under which the shipment is made), the quantity contained therein, the name of the contractor, and the number of the contract or order

G. Notes

1. If a manufacturer has a product which meets the performance guarantee and general requirements listed in this specification but which does not meet the specific requirements he may submit a test sample and complete specifications for that particular lubricant for approval of the standard specifications department the maintenance superintendent and the lubrication engineer. If the product is approved by the above mentioned parties and proves to be superior to products purchased on the present specifications its purchase will be approved by an addendum to this specification

2. This specification governs all purchases of this commodity. Users are requested to retain the specification in permanent file until revision is issued

3. The standard specifications department in Louisville maintains a file of extra copies of this specification. Persons within the organization desiring copies shall apply for them through the purchasing department

## TABLE IV—DETAILED CHARACTERISTICS OF GREASES THAT MEET THE SPECIFICATIONS

| | INDUSTRIAL —LUBRICATING GREASES— Seca 100, Cup Grease | Seca 101, Ball-Bearing Grease | TEST METHOD |
|---|---|---|---|
| Ash (as sulphates), %..... | 5 max | 5 max | ASTM, D128–40 |
| Corrosion..... | None | None | FED SPEC BD, No. 530.31 |
| Free alkali, %..... | 0.5 max | 0.5 max | ASTM, D128–40 |
| Melting pt, F..... | 150 min | 250 min | ASTM, D127–30 |
| Mineral-oil content, %..... | 80 min | 80 min | ASTM, D128–40 |
| Mineral-oil flashpt, F..... | 350 min | 350 min | ASTM, D92–33 |
| Mineral-oil pour pt, F..... | 5 max | 5 max | ASTM, D97–39 |
| Mineral-oil viscosity, SUV at 100 F, sec..... | 200 min | 200–500 | ASTM, D88–38 |
| Moisture content, %..... | 1.5 max | 0.5 max | ASTM, D95–40 |
| Penetration, worked..... | 310–340 | 310–340 | ASTM, D217–38T |
| Soap content: | | | |
| Lime, %..... | 11–16 | 3 max | ASTM, D128–40 |
| Sodium, %..... | 0 | 6–16 | ASTM, D128–40 |
| Total, %..... | 11–16 | 9–16 | ASTM, D128–40 |

mineral oil and fine odorless calcium soap made from animal or vegetable fats or oils or fatty acids, and completely saponified with hydrated lime.

Seca-101 grease shall be a smooth, cold-milled, short-fiber, soda grease composed only of soaps made from high-grade animal or vegetable oils or fatty acids and of a straight well-refined mineral oil.

B. Greases shall contain no fillers such as resin, resinous oils, soapstone, wax, talc, powdered mica or graphite, sulphur, clay, asbestos or other filler.

C. They shall be free of acids or uncombined alkalies and be noncorrosive to bearing parts in service or storage.

D. They shall have no oil separation in service or storage.

E. They shall possess only a slight odor of mineral and may be rejected if they have any other distinct odor.

F. The greases shall be of the same consistency and composition as the samples approved by the purchaser.

Most of the industrial lubricants in our plants serve several types of equipment. For example, our Seca-9 specification covers a compounded oil which lubricates steam-engine cylinders operating at pressures up to 180 psi saturated and heavy-duty wormgear speed-reduction units.

Instead of using two oils, one for cylinder and another for wormgear lubrication, which are almost identical in their characteristics, we combined the most exacting physical and chemical requirements for both oils into one set of specifications. Thus, to satisfy our steam-engine requirements, a very high-grade 5- to 8-% compounded, filtered cylinder oil was needed, but the 5- to 8-% compounded oil required by our wormgears need not be filtered. Nevertheless, our Seca-9 specifications were written to insure purchase of a *filtered oil* to satisfy all requirements of *both* equipments. This practice was applied wherever possible and though it pro-

(*Continued on page* 146)

## TABLE V—DIESEL FUEL-OIL SPECIFICATIONS

**REQUIREMENTS**

1. **PERFORMANCE GUARANTEE:** When supplying this fuel oil, the vendor guarantees the product to be suitable in every way as fuel for Ingersoll-Rand 8-cylinder 460-hp 600-rpm Type S diesel engines
2. **GENERAL:** The fuel oil shall be a completely distilled hydrocarbon oil, free from alkali and mineral acid, grit, fibrous material, and other foreign matter
3. **DETAILED REQUIREMENTS:**

| | | TEST METHOD | |
|---|---|---|---|
| API gravity 60 at 60 F..... | 30 to 38* | ASTM D287–39 | *This is equivalent to 136,500 Btu |
| Cetane no.**..... | 45 min | ASTM D613–41T | **The cetane number, a measure of the ignition quality of the fuel can be exactly determined only through the use of an expensive test engine and the services of an experienced specialist. However, an approximate cetane number may be calculated by means of the following formula: |
| Viscosity at 100 F, SUV..... | 35 to 60 sec | ASTM D88–38 | |
| Pour pt..... | 5 F max | ASTM D97–39 | |
| Flash pt, Pensky-martens..... | 150 F min | ASTM D93–40 | $\text{Approx Cetane No.} = \frac{1.1\ (AP)\ (\text{API Gravity})\ (50\%\ RDP)}{100{,}000} + 17$ |
| Carbon residue, on 10% residuum..... | 0.25% max | ASTM D189–41 | Where, AP = Aniline in deg F, and 50% RDP = 50% recovery distillation point in deg F |
| Sulphur..... | 0.75% max | ASTM D129–39 | |
| Water and sediment..... | 0.05% max | ASTM D96–40 | The aniline point shall be determined as described in ASTM designation, D611–41T and the 50% r covery distillation point shall be determined as outlined in ASTM designation, D158–41 |
| Ash..... | 0.01% max | ASTM D482–38T | |
| Corrosion test***..... | Pass | ASTM D130–30 | ***The corrosion test is performed as described in ASTM Designation, D130–30 using a temperature of 212 F instead of 122 F. The fuel does not "pass" the test if the discoloration of a freshly polished copper strip becomes opaque or if pitting is caused on any portion thereof |
| Distillation temperatures | | | |
| 90% Recovery pt..... | 650 F max | ASTM D158–41 | |
| End pt..... | 700 F max | | |

# THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS → ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER


# An Old Standby Finds New Uses

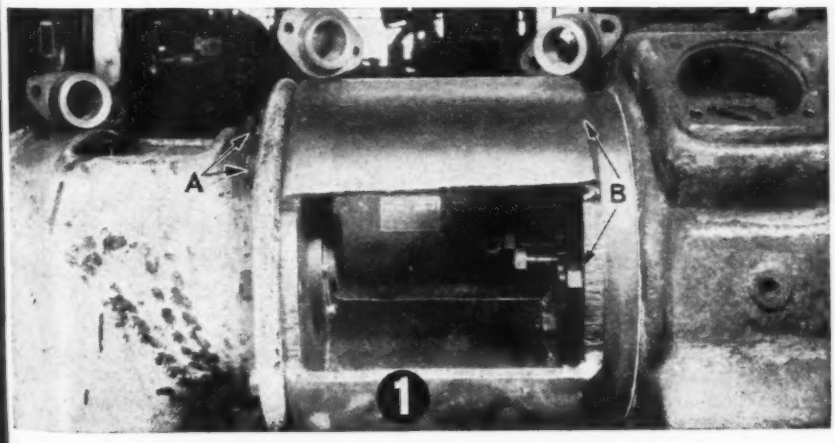
***Step by step, C H Tucker, American Air Compressor Corp, tells how to get out of a tight corner by converting a double-acting air compressor to oilless operation***

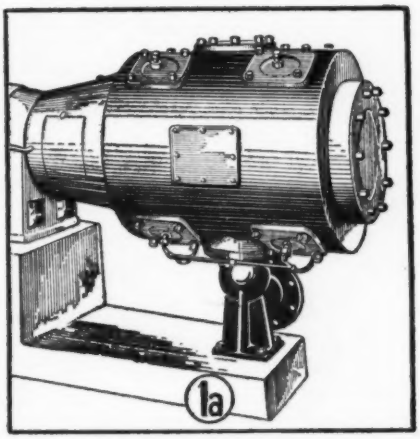
WHEN COMPRESSED AIR took over new duties in food-processing, vacuum-tube-manufacture and combustion-control systems it was compelled to appear for work minus the slightest trace of oil fumes. If danger of damage to products exists safest bet is to keep oil out entirely instead of depending on complete removal after compression. This means that oil cannot be used to lubricate the reciprocating-compressor cylinder.

Manufacturers build these machines to operate without oil lubrication, but if you have a double-acting machine and can't buy one for oilless operation, here are pointers for converting your old standby compressor.

To do the job right you need: (1) distance piece the same length as compressor stroke to hold the cylinder clear of oil carryover from crosshead by piston rod (2) new one-piece piston rod with tail extension to carry piston clear of cylinder walls (3) carbon insert bronze bushings for both front and rear cylinder heads and packing followers (4) additional packing gland in front head (5) tailrod guard mounted on front head (6) set of carbon piston rings with metal expanders (7) solid aluminum casting for the piston (8) substantial footpiece to support cylinder weight and (9) lubricated flexible-metal packing for piston rod.

The outlined procedure starts below and continues on page 108 showing all of the important operations necessary to complete the mechanical work.

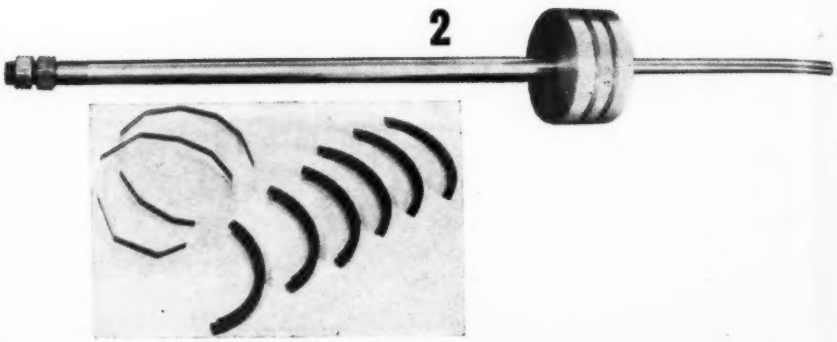


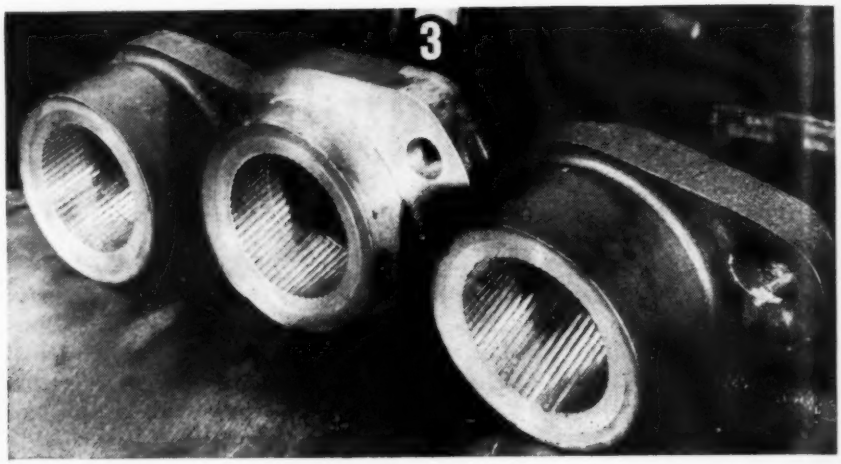




**1 Buy distance piece from manufacturer or fabricate one from boiler-plate steel. It must be strong enough to resist piston thrust load and carry the overhung cylinder weight. Suppose you have a 12-in. cylinder that compresses to 100 psi. Then $6^2 \times 3.14 = 113$ sq in. area of piston, and $100 \times 113 = 11,300$ lb, total thrust load. Overhanging weight can be determined with beam formulas. Proceed with caution at this point because extending the cylinder away from frame studs *A* stresses them considerably more than originally. Stress in studs *B* remains approximately the same. (Use a liberal safety factor and always provide a *footpiece*, 1a, to support the cylinder.) Machine the distance-piece end disks parallel to each other with accurate fit into the cylinder head and frame joints; otherwise, cylinder will not line up with frame center line. The distance-piece for this 12x12 in. compressor was fabricated from 0.75-in. boiler plate curved and welded to 1¼-in. end disks machined to fit frame and cylinder joints**

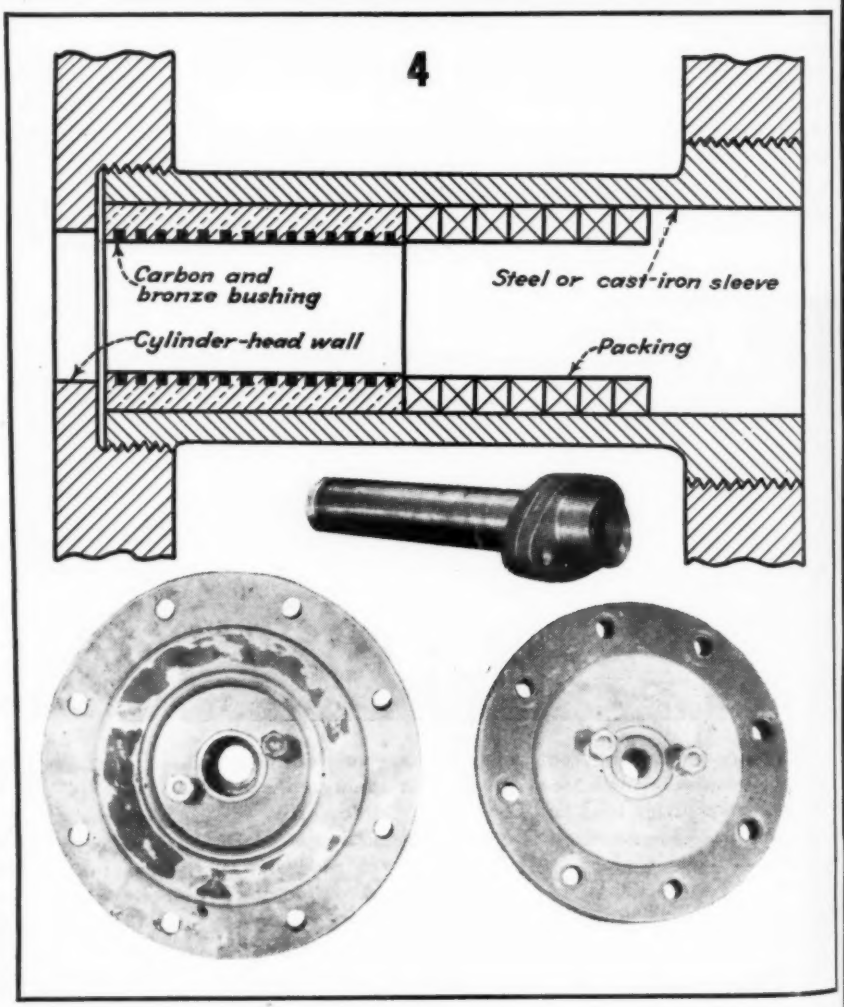
**2** As the distance piece moves the cylinder farther away from the frame a longer piston rod is required. Make it long enough to reach through the front head.

Machine the piston and tailrod in one piece with a tapered section to match piston. Tail section can be smaller in diameter (See photo.) because it carries no thrust load. This permits sliding the piston locknut up to threaded section ahead of piston and screwing it home. The extension or tailrod slides through a carbon lubricated bushing in front cylinder head. This floats the piston and prevents it from touching cylinder walls

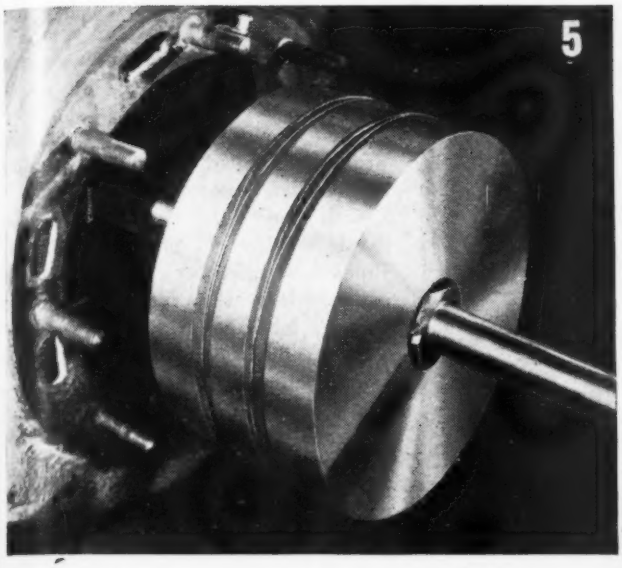



**3** Carbon-insert bronze bushings in each cylinder head, Fig. 4 and 6, and crankcase partition carry the sliding rod. Packing gland followers (See photo.) are also fitted with carbon and bronze bushings. As the rear head already contains a bushing, enlarge the opening just enough to press the new one in place, then key it with set screws threaded into the joint between bushing perimeter and cylinder head

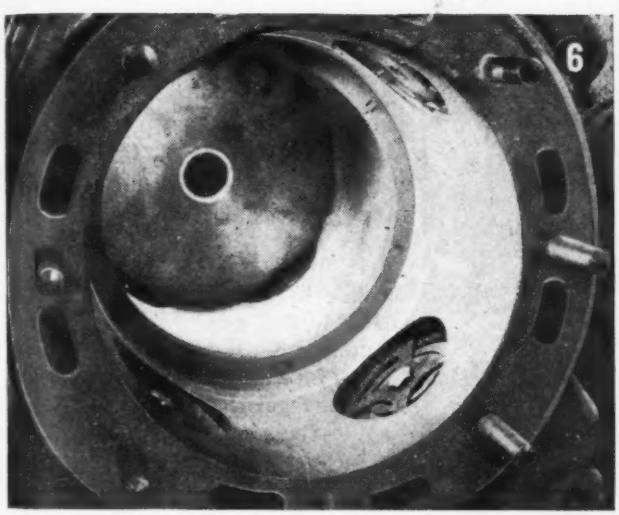



**4** Front head presents a different problem because water-jacket pocket must be penetrated. If boring will weaken the head purchase a new one cast with a center core, otherwise bore a hole perpendicular to head-gasket face large enough to pass the tailrod. Then leaving a substantial shoulder on the inner wall enlarge the hole to fit a full length sleeve containing the bronze bushing. Thread both ends of hole and sleeve making each complete thread-cut without releasing lathe carriage split-nut from lead screw, see sketch. Bronze bushing inside the sleeve also serves as a packing stop. The head (left) shows packing gland and bronze bushing (right) flexible metallic packing in place

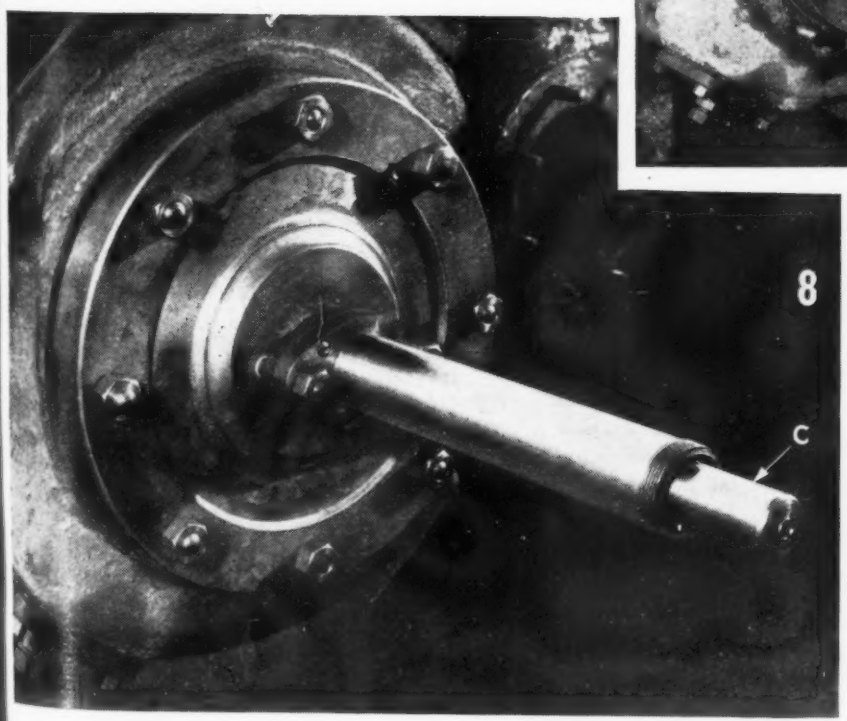


**5** Since the regular cast-iron piston is heavy, load on piston-rod bushings can be reduced by using an aluminum piston. Make one from a solid block to eliminate trouble from unequal expansion that may occur in a hollow casting having walls of uneven thickness

After machining piston to correct size cut grooves for carbon rings. Make them deep enough to allow for expander rings of 1/32-in. spring steel, bent as in Fig. 2



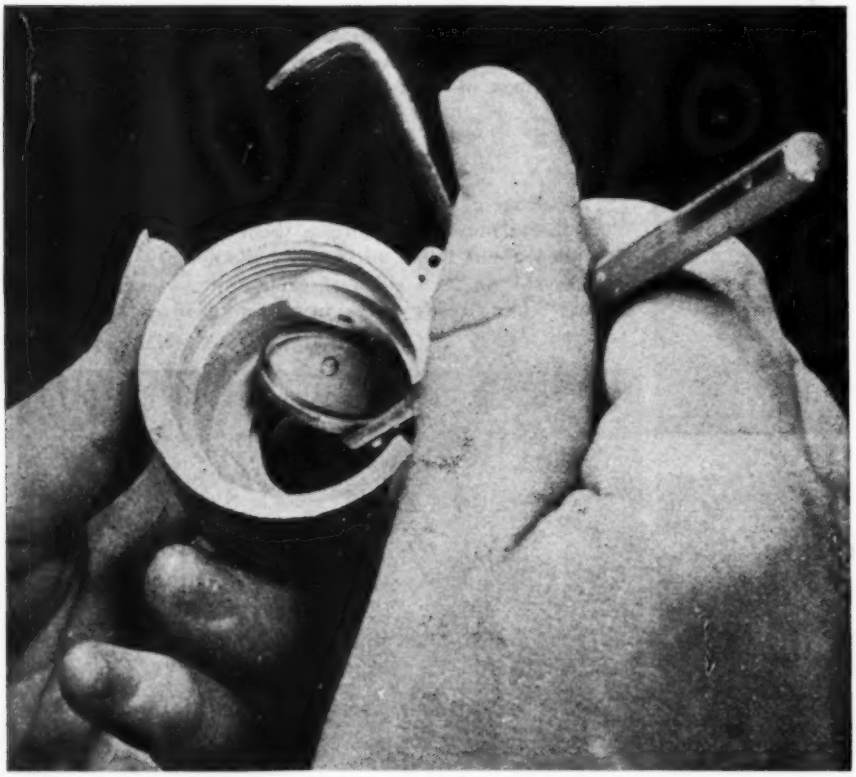
**6** Purchase a set of carbon rings and fit them to the cylinder bore. After fitting them correctly (total joint clearance about 0.001 in. per in. diameter) scribe reference marks on both sides of each joint to assure correct mating when fitting rings in piston grooves




**7** Put expander rings and carbon segments, photo 2, in place and tie with cord, photo 5. Push the piston in cylinder slowly so that the ring edges do not chip; cord will push off as piston slides in. Screw piston rod in crosshead but don't tighten crosshead locknut until piston clearance has been adjusted

**8** Button up the job by putting on the head and gasket. Insert rod packing, put gland follower and tailrod guard in place and draw up the gland. After adjusting piston clearance measure and cut off excess part of tailrod *C*. A pipe cap then closes end of tailrod guard

# PRACTICAL AIDS TO OPERATION



## How to See Around a Corner

AT THE WESTINGHOUSE PLANT, East Springfield, Mass., dental mirrors are used to locate tiny burrs on the inside of bomb fuses, as in the photo, so that they may be removed. A dental mirror, kept in a protected place in his tool kit, is a handy device for every mechanic or electrician, for seeing around corners or in places that normally cannot be seen when making inspections or repairs. Many readers no doubt are familiar with this little tool for inspecting the inside of meters and other obscure places. However, probably many others are not and this kink is passed along to help them. To see the underside of an object without actually looking at it, place the mirror below it and look in the mirror, as is being done in the photo.

## Fifteen Ways to Reduce Water Costs

USING WATER CARELESSLY may be expensive or, even worse, cause a shortage. When water is purchased, waste means excessively high costs; when pumped from wells or other sources, power for pumping and wear on pumps are much greater than they should be. If your plant water system keeps waste at a minimum, you can answer Yes to the following questions. If you cannot, get busy and check up on places where waste may occur:

1. Are all water sources metered, and are the meters accurate?

2. What types of meters are used? If water consumption is relatively small, ordinary displacement meters are satisfactory. If large volumes are used, a recording and integrating flowmeter helps show what is going on in the system at all times and provides a record for future comparison.

3. Do you meter water to all large users in the plant? If you don't, a lot of water may be wasted that you know nothing about.

4. Do you check sub-surface leakage? It may drain off a large amount of water without indication on the surface.

5. Does your pumping equipment operate at best efficiency? A surprising amount of power can be wasted in improperly applied, poorly maintained and obsolete pumps.

6. Is the water-distributing piping ample in size and properly laid out? Pipes too small or poorly arranged cause an increase in pumping head that wastes a lot of power.

7. Are pump drives the most efficient for operating conditions?

8. Do pumps operate against an unnecessarily high pressure just to supply a few minor demands? If they do, drop the system pressure to where it should be and install a small booster pump for high-pressure service.

9. Are plant operations scheduled to smooth out demands for water?

10. Where water is used for condensing or cooling, are you operating with as high an overflow temperature as is economically feasible? Recording thermometers, temperature controllers, calibrated valves and, in some cases, indicating flowmeters greatly reduce water use.

11. Is all water flowing to waste made visible by sight devices, such as funnels, so that excessive flow is readily detected?

12. Do you inspect all water-using devices regularly to make sure they are not leaking? A lot of small leaks waste a surprisingly large amount of water.

13. Are needle, globe or flow-control valves used on the inlet of all water-using devices so that throttling is accurate?

14. Have you explored the possibilities of using water for more than one purpose, such as water from coolers for domestic hot water?

15. If you are buying water, have you investigated the possibilities of developing your own supply?

*Staunton, Va.* S H COLEMAN

## Air Engine Drives Tube Cleaner

WE HAVE eight 7x18-ft hrt boilers each with 132 three-inch tubes. Because of the labor situation, cleaning these tubes became such a chore that I built an air-driven cleaner from material picked up around the plant. For the cylinder of the air engine we used a piece of standard 2-in. pipe, 20 ft long.

To smooth and polish the inside of the pipe we fitted two ¾x¾x3-in. grind-

ing stones in slots in opposite sides of a hardwood cylinder, Fig. 1. We mounted this on the end of a ⅝-in. rod, as shown, and used our tube-cleaner turbine to rotate the grinding head inside the pipe.

We put a cap, *A*, with a hole in its side threaded for a ¼-in. pipe, on one end of the air cylinder, Fig. 2. On the other end we placed a coupling with a hole tapped into its side for a ¼-in. pipe. An old valve bonnet threaded into the coupling, at *B*, completed the cylinder. A ⅜x2x8-in. spring was placed in each end of the cylinder to cushion piston at the end of its forward and reverse strokes.

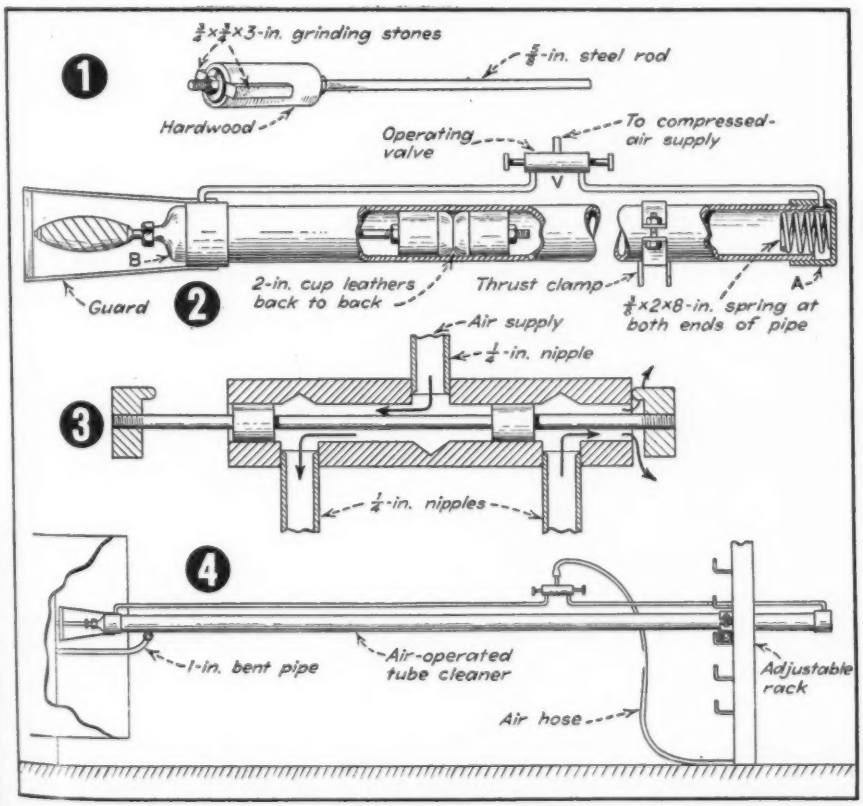
A length of ⅝-in. cold-rolled-steel rod connected the tube cleaner to the piston in the air cylinder. We made the piston in two parts with two 2-in. cup leathers placed back to back in its center, to seal the piston in the cylinder for both directions of operation, Fig 2.

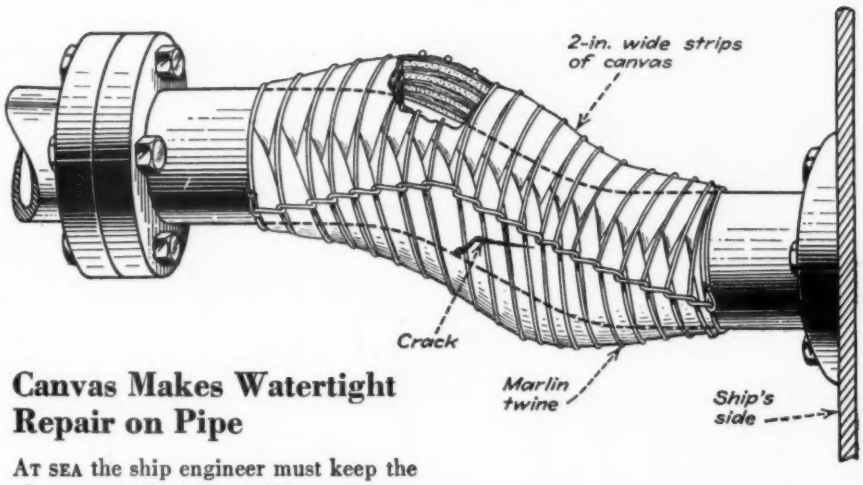
To operate the air cylinder we made a valve, *V*, in Fig 2, from a 3-in. piece of 1¼-in. round brass with a ⅜-in. hole through its length, Fig 3. We tapped three ¼-in. pipe nipples into the side of the valve, as shown. A double piston lap-fitted inside the cylinder completed this valve. The valve pistons are so placed on their stem that when one is positioned to admit air to one end of the cleaner cylinder, the other piston opens to exhaust. Then, by a small endwise motion of the valve piston, air is admitted or exhausted from either end of the cylinder at will.

We connected the valve to the cleaner air cylinder and welded a conical guard around the cleaner to the coupling on the cylinder, as shown in Fig 2. This guard also takes the forward thrust of the cylinder when its piston is in back stroke pulling the cleaner out of a tube. Thrust on the forward stroke is taken care of by a clamp on the rear end of the cylinder. This clamp fits on a bar in an adjustable rack attached to a line of posts that happened to be in the right location. Fig 4 shows the air cylinder in place to clean a tube.

This crude air engine has proved to be a great labor saver and has materially reduced the time required to clean the boiler tubes. In addition the firemen like to use it.

*Port Moody, B. C.* E DARNEY




## Canvas Makes Watertight Repair on Pipe

AT SEA the ship engineer must keep the plant going if at all possible, and in an emergency, the means are many and varied. On one ship a 6-in. copper circulating-sea-water line, to an auxiliary condenser cracked about 10 in. along one side. Pressure in this line was about 8 to 10 psi.

To repair the pipe when in service, we gave it a good coat of heavy white lead. We then cut heavy canvas into 2-in. strips and wrapped the pipe with layers of it, extending about 15 in. beyond each end of the crack, as shown in the drawing above.

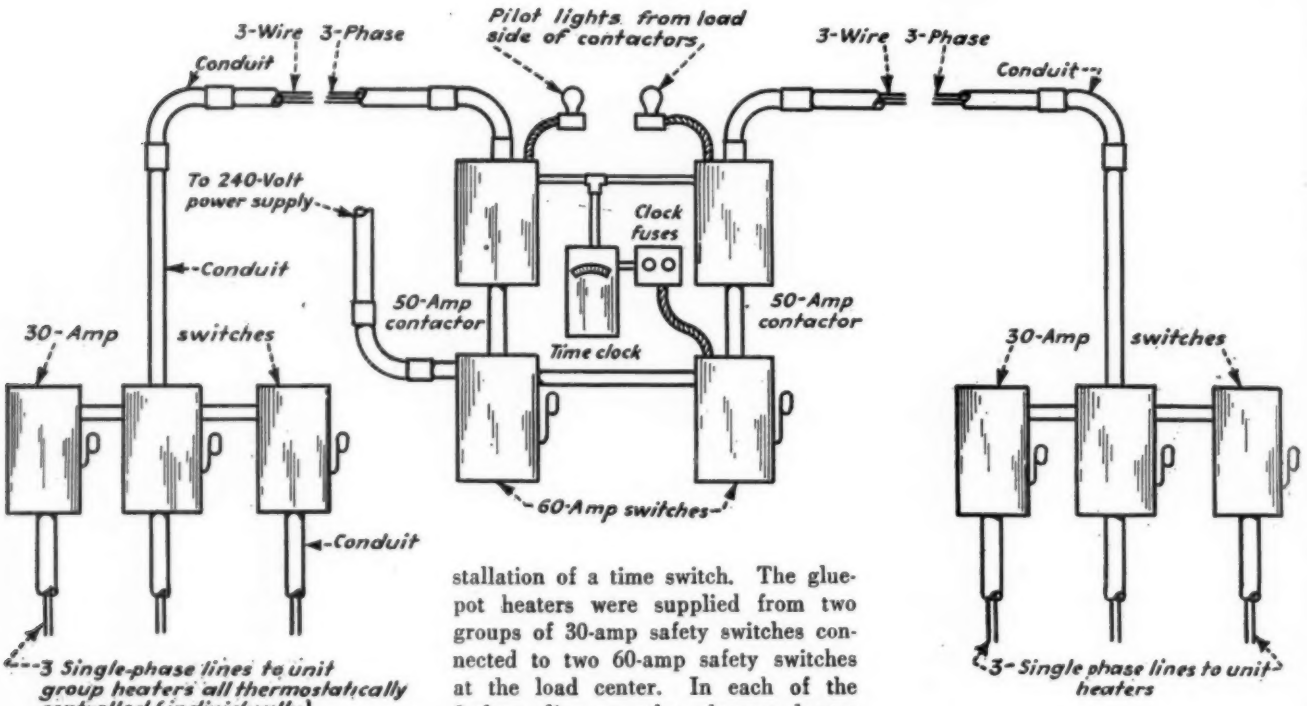
Over each layer we applied a coat of white lead, and completely stopped the leak with five layers of canvas. We secured the last layer with heavy marlin twine. This job produced a hard casing of canvas and lead, without leaks, that was still in service, three months later when I left the ship.

*Great Neck, L. I.* S M ELONKA

## Time Switch Controls Electrical Heaters

IN OUR PLANT WE USE several glue pots that set in water heated by electric heaters. When these pots are cold the electric heaters must be energized for three hours before the glue reaches proper temperature. To have the glue at the correct temperature when the employees went to work at eight o'clock it was necessary to have a man come in every work day three hours early to close the glue-pot heater switches.

This arrangement had several objec-




tions: The cost was high, the job being done on an overtime basis, at a 50% increase in pay; the man did not always get in on time and then the glue would not be in proper condition at 8 o'clock for the machine operators to start work. These and other objections made automatic switching of the glue-pot heaters desirable.

We solved this problem by the installation of a time switch. The glue-pot heaters were supplied from two groups of 30-amp safety switches connected to two 60-amp safety switches at the load center. In each of the 3-phase lines to the glue-pot heater switches we installed a 50-amp magnetic contactor and connected the relay coils of these contactors to the time switch, as shown in the diagram. A small neon pilot lamp connected to each contactor showed whether it was closed or open.

This arrangement has operated satisfactorily. In normal operation the switch is set to turn the glue-pot heaters off a half hr before quitting time and turn them on three hours before starting time. Saturday and Sunday weekends are normally omitted from the switch schedule. On holidays or on any other regular work day that the plant is shut down the clock is set to omit these days from its schedule. Outside of these special cases, once the switching schedule is set up, the clock follows it automatically without attention.

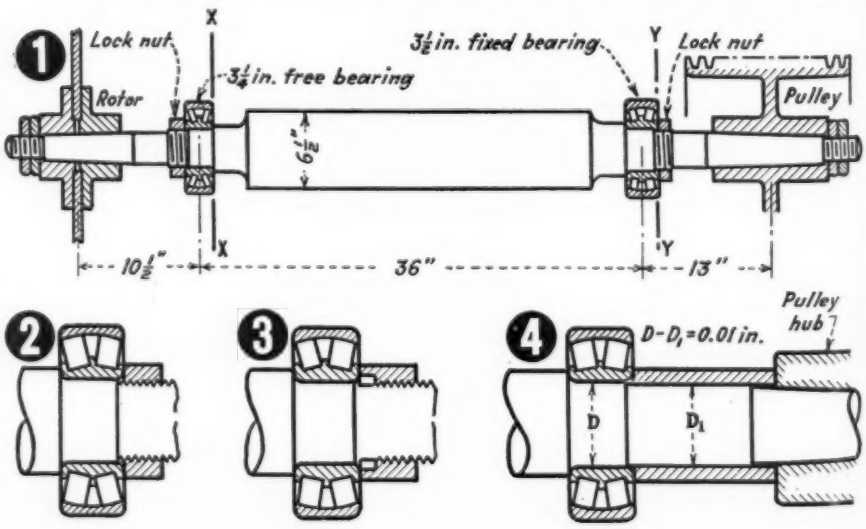
*Englewood, N. J.* R BOETTINGER

## Over-Stressed Thread Causes Shaft Failure

DESIGNERS sometimes forget the lessons of the past, and recently I ran into the old trouble of excessive stresses in the thread on a shaft. Fig. 1 shows the shaft supported by two roller bearings, one fixed and the other free in its housing, and having an overhung load at each end. In its center section the shaft was made very heavy to place its critical speed well above the designed overspeed.

Two shafts of this design broke, one at *X-X*, the other at *Y-Y*. While the heavy center section made this part of the shaft rigid and the large reductions in shaft size caused high-stress concentration at their radii, poor design of thread and nut caused the fracture at *Y-Y*. As shown in the enlarged section, Fig. 2, thread for the nut extended right up to the bearing-seat shoulder and created an inherent weakness in the shaft. If the bearing was to be locked to the shaft with a nut, it should have been done as in Fig. 3. This method relieves high-stress concentration in the root of the thread.

When we installed the third shaft we locked the inner race of the bearing with a sleeve between it and the pulley hub, Fig. 4. This method eliminated threading the shaft and possibilities of high-stress concentrations in the thread. Not relieving threads on shafts, spin-

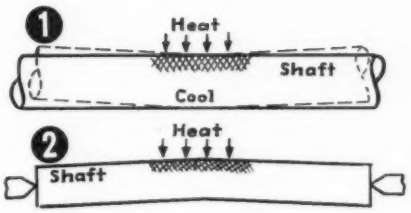


dles and bolts is still a common fault in mechanical design in spite of many failures due to this cause.

*Johannesburg, South Africa* H DOUGHTY

## Bent Shafts Straightened by Heating

STRAIGHTENING BENT SHAFTS by local heating with a welding torch has worked successfully in our plant. Fig. 1 shows that if a straight shaft is heated on the top side, while keeping the lower side cool, it will bow up in the center. When it cools, it will bend down in the center, as exaggerated by dotted lines.

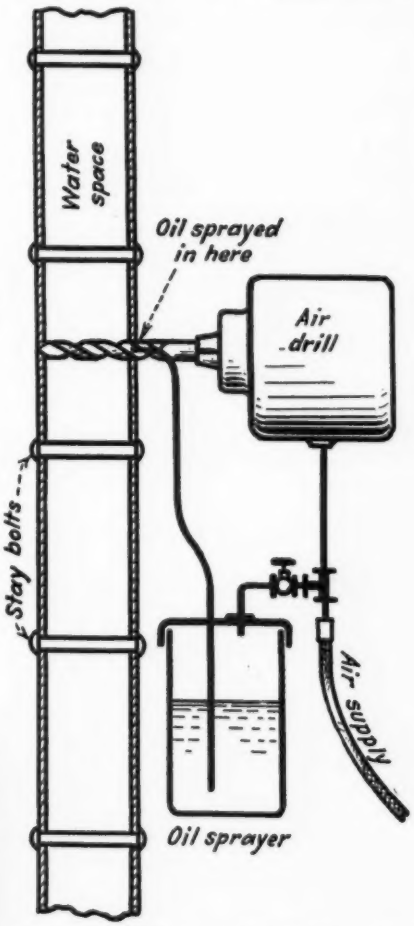



This action applies inversely for straightening bent shafts, as in Fig. 2. Bent shaft is centered loosely, as in a lathe, with bend on top. Apply local heat with a welding torch to top side of bend, as indicated, keeping inner side as cool as possible. When cool, the shaft will have lost at least part of its bend. By a process of heating and cooling, it can be gradually straightened.

*Toronto, Ont.* DAVID A BURMA

## Lubrication Solves a Tough Drilling Job

WE HAD TO DRILL several hundred holes for additional 7/8-in. staybolts between the staybolts already in place in the water legs of one of our boilers. When we started, we had only one carbon-steel drill on hand. After a fruitless effort to obtain additional drills we had to do the work with only one, and grind it when dull. Then I found that I was the only one who could properly grind the drill. Chief cause of dulling the drill was the scale on the fire wrapper sheet,




because sufficient lubricant was not reaching the drill end when in this sheet.

As the diagram shows, a paint sprayer, to blow lubricant along the drill to its cutting edge, solved our problem. As indicated, we connected the sprayer into the air line supplying power to drive the drill. With proper lubrication, the drill could be used several hours without sharpening, whereas before it had to be sharpened after drilling 7 to 9 holes. The job was then completed without encountering any serious difficulties.

*Schenectady, N. Y.* CARL BACHMANN

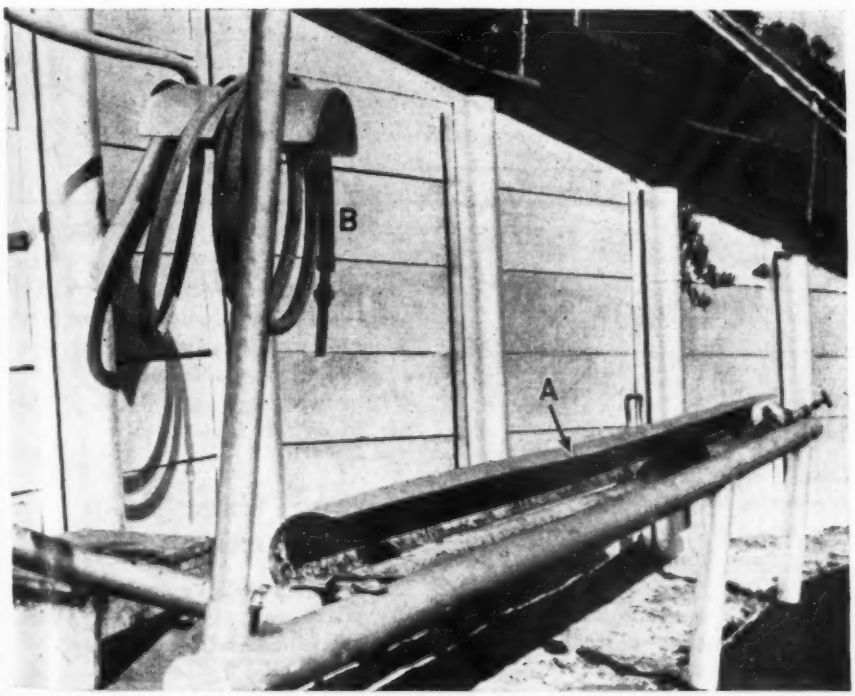
# Hose Protected by Careful Sheltering

TO PROTECT scarce rubber-composition fuel hose from sun and other deteriorating elements, the operators of one plant constructed a conveniently located hose shelter and holder from a section of used 6-in. pipe, slightly longer than the hose itself. They cut this pipe in half lengthwise and hinged the two sections together at several points along one side. As shown in the photo, the lower half of the hose container is bolted to a pipe guard rail in such a way that the top half, or cover section at *A*, closes down to form a weatherproof receptacle. A handle welded to the cover aids in opening the enclosure.

Instead of coiling the hose as so many do, they lay it out in a full-length position, which prolongs its useful life by eliminating causes of cracks in the rubber compound and leaks along its length or at end fittings.

To further protect the hose, a water outlet and hose is installed on a handy rack, as at *B*. This is used for washing off deteriorating splashes of fuel oil from the rubber exterior before putting it away in its receptacle. Note that the water hose is hung over a section of large radius pipe to prevent bending it sharply as when hung on a hook.

*Pomona, Calif.* G M WILSON



# READERS' PROBLEMS

## Questions From Our Readers

### *Question 1*

### What Causes Carryover?

We have 3 hrt boilers connected to a common 14-in. header. Main load for the dye house comes off the top at one end of this header, which is trapped on the lower side. Steam for auxiliaries and finishing room is taken off at other points of the header but the main load is on the dye-house line.

The largest boiler (175 hp oil fired) delivers steam to the header farthest from this main steam delivery line. No. 2 and 3 (125 hp) were until recently oil fired but are now equipped with stokers.

Carryover is heavy and was not corrected by changing from oil to coal firing of No. 2 and 3 boilers. No. 1 boiler is equipped with a steam dome. Dry pipes were inserted in No. 2 and 3 boilers without noticeable reduction in carryover. No. 1 boiler delivers its steam through a 5-in. diameter gooseneck while the smaller boilers have 6-in. lines. Boilers operate at 80 psi and use a hard well water softened by treatment.

There has been no difficulty in building up 18 to 20 concentrations in No. 1 boiler. But concentration seldom exceeds fie in the two smaller boilers although water column and blowdown lines are tight so that leakage does not occur at these points. This indicates that heavy carryover from these boilers is not caused by high concentrations because it continues when city water of relatively low mineral content is substituted for well water.

All boilers occasionally carry heavy overload, but in the absence of meters exact load cannot be determined. Low concentrations which occur in boilers 2 and 3 hold the alkalinity down to 10 to 20 grains with total concentrations of 150 to 200 grains. Total concentrations were much less when city water was tried.

Would taking the main steam load off the header from a point near where the 5-in. gooseneck from No. 1 boiler enters the header reduce this carryover? I have noticed that in a battery hookup boilers nearest the point where steam is taken away tend to lose water.—*BTF*

### *Question 2*

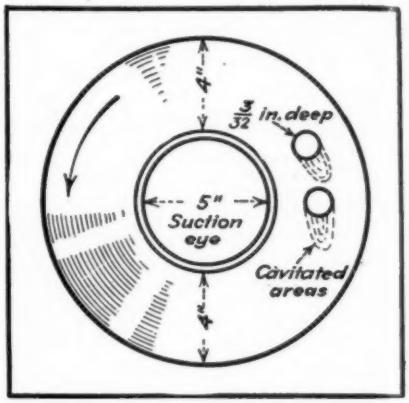
### How Is This Pump Trouble Corrected?

We have a 2-stage 500-gpm 1800-rpm 240-ft head single-suction centrifugal pump that has two blind holes drilled in the impeller, as shown in the rotor sketch.

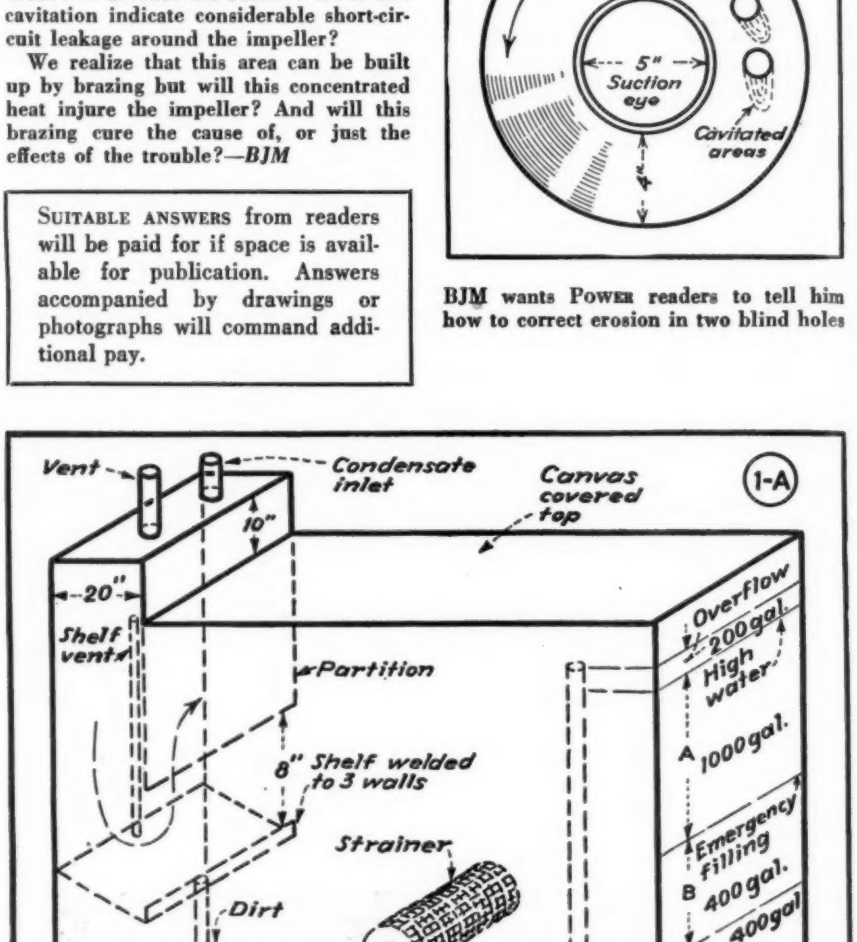
Erosion or cavitation at the two dashed-line areas is serious enough to unbalance the runner. What can we do to correct this trouble? Were these holes originally drilled to balance the runner? Does this cavitation indicate considerable short-circuit leakage around the impeller?

We realize that this area can be built up by brazing but will this concentrated heat injure the impeller? And will this brazing cure the cause of, or just the effects of the trouble?—*BJM*

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers accompanied by drawings or photographs will command additional pay.




BJM wants POWER readers to tell him how to correct erosion in two blind holes




## Answers to Nov. Question 1

### What Size Condensate Tank?

*I would appreciate information on good practice in determining size of condensate tanks relative to boiler capacity, taking into consideration various steam loads.*

*Since the tank absorbs surges in boiler demand for water and the returning condensate, it must be sized accordingly. I fully appreciate that boiler demand for water and uneven condensate return depends on type of load, such as sudden demands for large quantities as against steady steam flow. What size tank do you use?*

*I would like opinions of other* POWER *readers on this subject.—MP*

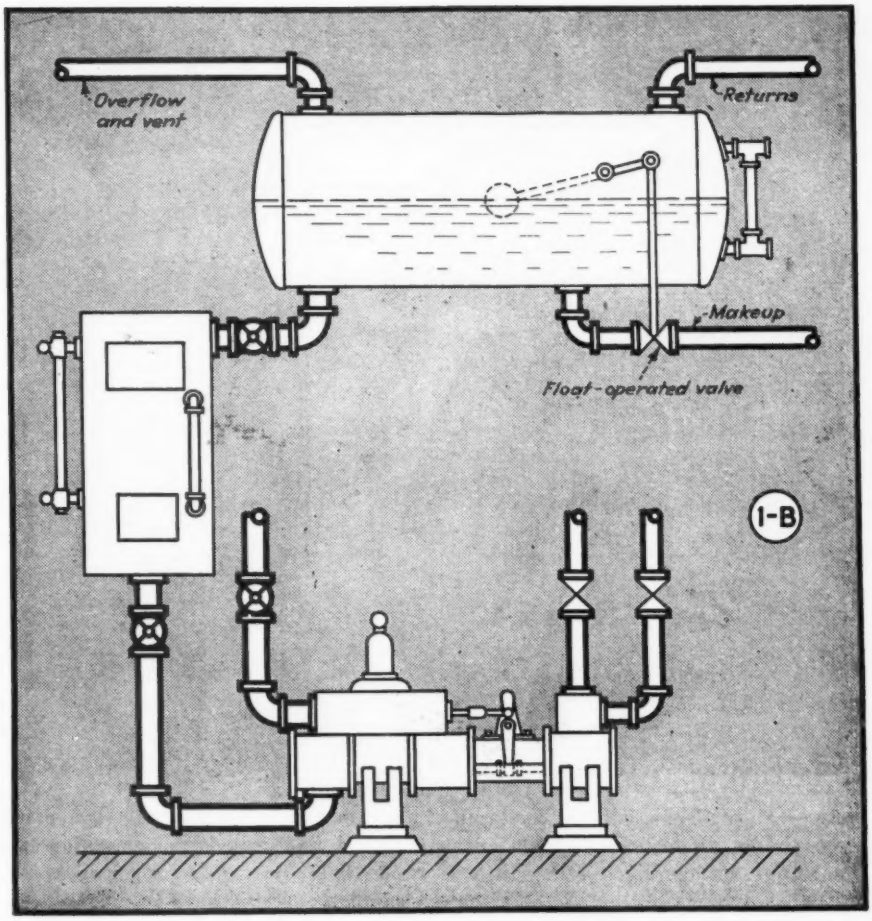
### Makeup Water from Air Compressors

LAST SUMMER we were confronted with a similar problem which we solved, sketch 1-A, by installing feedwater storage sufficient for 15- to 20-min supply.

Tank contains a dirt settling area with safe condensate margin below overflow point. In addition, we installed a float to indicate the water level on a scale board.

An electric float switch opens a ¾ in. solenoid valve in the makeup water line. Makeup water comes from air-compressor cooling discharge and is sufficient to supply the daily 5% loss. We meter this water and discharge it into the heater-return vacuum-pump tank.

*Cleveland, Ohio* H M Nobis




## Must Handle Condensate At Full Load

MP can determine amount of returns (in lb or gal) available without any special test equipment.

Recover all the condensate into barrels and as one is filled, measure or weigh the contents. While this is being done another is filling up. Continue measuring until a good average of existing conditions is secured, preferably for 24 hr or more.

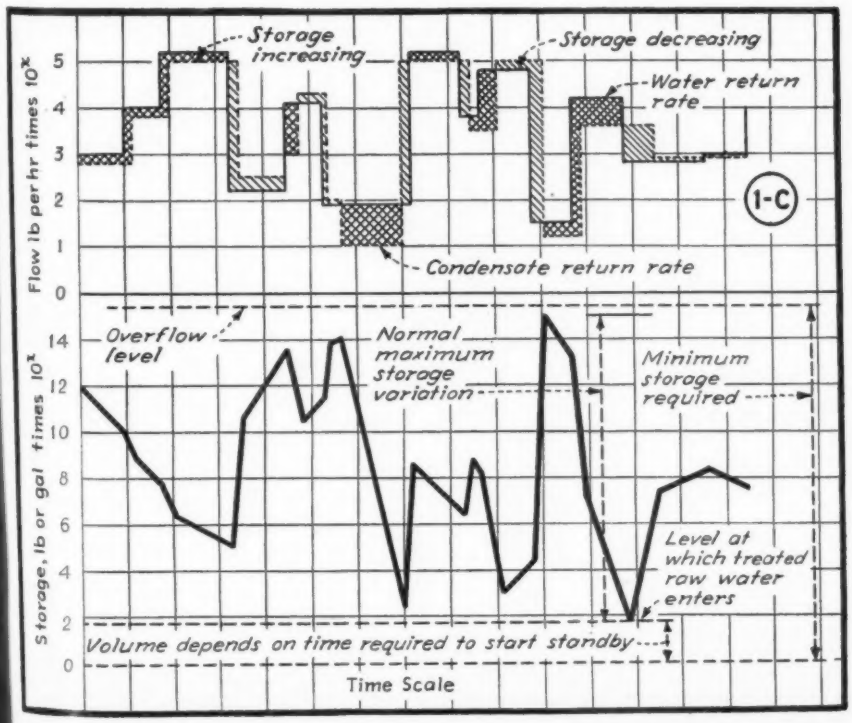
If this test includes all condensate to be used for boiler water, the sum of all returns will be the amount of recovery. Difference between this quantity and the steam output (including blowdowns) is the amount of makeup water necessary.

I suggest that the surge tank be sufficiently large so that it will handle the condensate at full load and be kept half full, thus requiring minimum makeup.

Makeup line should be large enough to supply water for full-load capacity. It should also be equipped with a vent and overflow. Condensate return lines should have bypass valves so the tank may be taken out of service for cleaning.

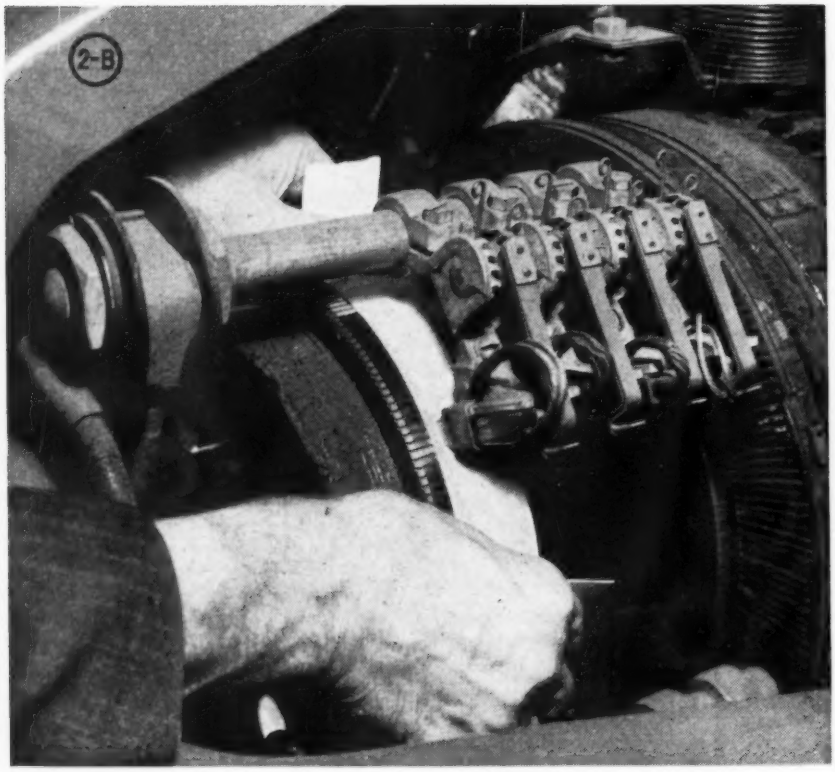
In the sketch 1-B, all returns go to a header and are then pumped into the surge tank, mounted over the heater, to assure a definite head. If returns can be piped direct to the tank a pump is not required.

*Bogota, N. J.* F O Meyer




## Estimate or Measure Flow Rates

If MP can measure or closely estimate rate of condensate return and boiler feed simultaneously he can calculate required tank size. Method is shown on chart 1-C. Flow rates are plotted against time to convenient scales. The record should cover sufficient time to represent normal variations completely. From the flow data all variations in condensate storage are calculated and plotted below the flow-rate curve in units of lb or gal against the same time scale. When water-flow rate to boilers exceeds condensate-return rate, condensate storage decreases. When the flow rate lines intersect, storage condition reverses and the quantity of storage increases or decreases accordingly. The quantity involved between intersections of flow-rate lines is determined by the area




between them. Thus, if boiler feed rate exceeds condensate return by 400 gpm for 10 min, condensate storage will decrease by 4000 gal.

When the curves are completed maximum variation in condensate storage is shown by the difference between the maximum and minimum points. This is the active storage tank size required if condensate is to be completely utilized. Below the minimum storage level a volume of normally inactive storage should be provided for emergency based on a supply for average load lasting until standby equipment can be started. Also a float-controlled connection should be installed at the normal minimum storage tank level to admit treated makeup water as necessary. The required tank size is then shown by the corrected graph. It may not be reasonable to have the tank size adequate for extreme variations and this graph indicates what losses result from using any specific tank by drawing the appropriate horizontal lines.

*Saint John, N. B.* C G CLARK

## Length of Lines Affect Tank Size

IF MP MEASURES the volume of water required to bring the level in his boilers from the lowest to the highest operating level he will have a minimum basic size for his condensate tank.

However, his plant may have equipment that operates periodically, discharging relatively large quantities of condensate at considerable distance from the boilers so that when it reaches the boiler room there is more than enough to fill the basic size tank mentioned above. Under these conditions the tank should be large enough to hold this periodic surge, provided its frequency justifies increased cost of the tank capacity.

A plant having long steam lines may require a large volume of water to fill them with steam but heating periods may be so infrequent as not to justify additional cost of saving the condensate. Size of tank must be determined by the conditions in each plant.

*Franklin, Ind.* I A BUTCHER

# Answers to Nov. Question 2

## Coarse or Fine Sandpaper?

WHAT GRADE OF SANDPAPER *gives best results when sanding-in commutator or collector-ring brushes? Naturally, the coarse size cuts faster but it also produces a rough finish. Does this roughness produce brush contact quicker than a smooth face produced by fine sandpaper?*

*If the brush face is shaped true isn't a smooth contact preferable to one of sharp ridges?*

*Will one grade of paper fill interstices between grains of sand with carbon faster than another grade? And does this filling have any effect on accuracy or trueness of the sanding? If brush shape fits the commutator accurately does roughness of contact affect breaking-in of new brushes?—ADP*

## Start With Coarse Sandpaper

ADP SHOULD USE coarse sandpaper of 2/0 size until brush is ground to fit collector ring or commutator and then use fine sandpaper, 1/0 grit, until brush face is shaped true.

Fine sandpaper fills interstices between sand grains with carbon faster than coarse. This has no effect on accuracy or trueness of sanding if you always pull sandpaper in the same direction as the commutator or collector ring rotates.

A brush that is faced off with fine sandpaper breaks in quicker than one faced with coarse.

*Vienna, Md.* N W EVANS

## Fine Sandpaper Clogs On Soft Brushes

THE PROPER GRADE of sandpaper when sanding in carbon brushes depends on the amount of fitting required and brush material.

The object in sandpapering brushes is to fit them as closely as possible to the commutator or collector rings, so that the entire brush face may make good contact and thus allow the brush to carry its full share of current.

Use coarse sandpaper to cut a new brush down quickly, then make the final fitting with fine paper to give the smoothest finish possible.

If considerable fitting is required, particularly on the softer grades of brushes, fine sandpaper is usually unsatisfactory as it clogs rapidly with carbon dust and becomes useless. The ease with which this rough shaping of brushes can be done with coarse sandpaper affords a better chance of holding the paper tightly to the commutator, as in sketch 2-A, and prevents rounding of brush edges, which would occur if the paper were held improperly (dotted lines).

Brushes sometimes contain "glass hard" spots from which annoying

squeaking and chattering may develop. Resurface such brushes lightly with fine sandpaper. Regardless of the grade of sandpaper wipe brushes carefully after fitting to remove any sand particles that might be partially embedded in the comparatively soft brush face.

*Jersey City, N. J.* I S CHAMBERLAIN

## What Other Items Affect Brush Operation?

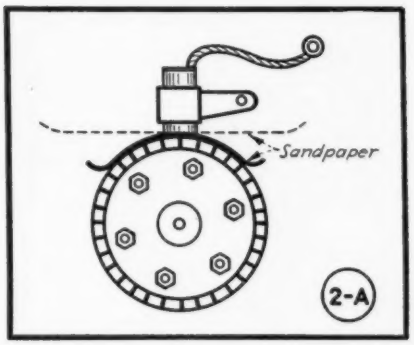
SEATING OF BRUSHES to commutators and slip rings is an old subject, discussed voluminously without being exhausted, as ADP's question would indicate. Probably emphasis has been put on the minor part of the problem. No amount of seating brushes to a commutator produces good operation unless other conditions, which include the following, are correct:

The commutator surface, proper undercutting of the mica, distance between brush-holders and commutator, angle brushes make with the commutator and equal spacing around it, alignment of brushes with commutator bars, fit of brushes in their holders, characteristics of brushes, staggering of brushes across commutator surface, brush contact pressure on commutator, correct setting of brushes on commutator neutral, not to mention many conditions of the rest of the machine that affect brush operation.

If all conditions except brush seating are correct, the machine generally operates satisfactorily. I have inspected brushes that had two angles across their faces (1) angle on the face when the brushes were put into the holders and never seated to the commutator (2) angle worn across part of the face by contact on the commutator. This machine had been operating with sparkless commutation. Needless to say, I seated the brushes and cussed the careless guy who did the job. But the fact remains, machine operation was highly satisfactory when I just stuck the brushes into the holders.

One plant contains large exciters that have a great many brushes, and as they wear down to the safe limit they are replaced one by one. The new brushes, when made, are beveled to the approximate angle they make on the commutator, but are not seated to the commutator except as they wear in. This practice has been followed for many years and the machines have always commutated perfectly. This again emphasizes the point that if all other conditions about a machine are correct for good commutation the way brushes are seated to the commutator does not make much difference.

No matter how carefully brushes are seated with sandpaper, fit is not perfect because sandpaper thickness makes the brush-face radius greater than that of the commutator surface. As a result, the brushes make contact at their center, with their heel and toe several ten thousandths away from the commutator surface. Unless care is taken to hold the sandpaper down on the commutator surface when seating brushes, their heel and toe may be several thousandths of




an inch away from the commutator, photo 2-B. Using a brush-seating stone to seat the brushes should tend to eliminate this difficulty, photo 2-C.

All this is not an argument against seating brushes to the commutator. I believe it should be done carefully, but it is only a minor item among a lot of far more important ones that must be given consideration before brush and commutator operation can be judged satisfactory.

*Philadelphia, Pa.* R O SPENCER

## Revolve Armature Mechanically

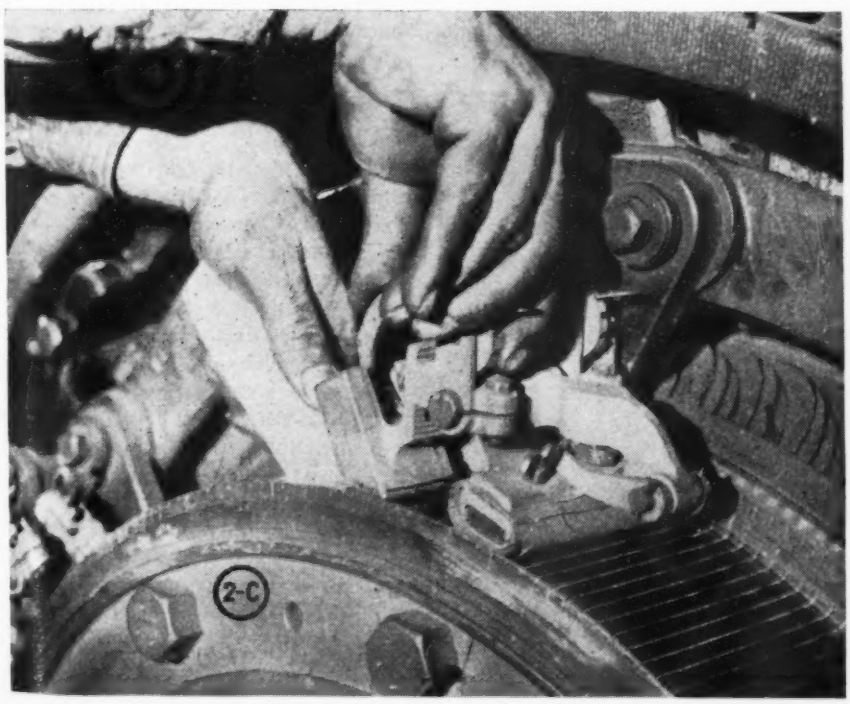
Best results are obtained by first using a coarse grade of sandpaper to cut down the brush face to desired shape, then smoothing it with fine paper. Finishing should be done only in the direction of rotation, lifting the brush away from the abrasive during return stroke.

Do this with each brush individually or, if a wide band of sandpaper is available, cut all brushes to shape at the same time by fastening the paper securely to the commutator. Then place the brushes in position, checking them for correct fit and alignment, and revolve the armature by mechanical power or hand until brushes fit curvature of the commutator. Finish each brush, of course, individually with fine sandpaper.

The brush should never have a rough face but always be as smooth as possible. It will not make quicker contact with a rough than a smooth face, because with a rough face, only part of the brush makes contact, whereas on a smooth one the entire brush contacts the commutator. If the brush is made of a hard grade of carbon it may form grooves in the commutator to match ridges on the brush. This happened on one of our exciters, making it necessary to recut the commutator surface.

If brush shape fits the commutator but has a rough surface the brush may chatter and cause more heating until it is seated to the commutator. There will

(*Continued on page* 150)



**REFRIGERATION NOTEBOOK — 10**

# Two Ways to Operate A Float-Expansion Valve

By TERRY MITCHELL, M E, *Frick Company*

When Jacob Perkins patented the first compression refrigerating system 110 years ago, he designed the expansion valve to be automatic in operation. The valve was held on its seat by a weight, and was to be opened by the liquid pressure as the condenser pressure rose. In a sense this was a crude kind of float valve, as it "floated" on the liquid pressure, and lifted or fell as load varied; it also had the advantage, in common with the modern float control, that most of the liquid stayed in the evaporator.

But hand-expansion valves were considered most practical for regulating ammonia flow until about 1910, when the "flooded" system came into general use. This employed an accumulator, arranged to catch and return to the cooler by gravity any liquid ammonia coming over with the suction gas. This system was semi-automatic, and was considered adequate until the full-automatic plant came along, bringing new problems.

Many different and successful expansion valves, actuated by temperature, pressure, superheat, or changes in level within the evaporator, are now in use. The float valve is perhaps the simplest as it works under natural laws and requires no fine, critical adjustments.

The float operates the valve stem through a hinged arm and loosely connected links: a counterweight makes the action sensitive to slight changes of liquid level. Position of this counterweight can be varied by means of adjusting nuts, to give some leeway to the control setting, after float position has been fixed in the pipeline.

There are two methods of connecting the float control in the system: Arrangement generally preferred for shell evaporators is to have the float regulating the liquid refrigerant level in the evaporator. Here, float valve is placed on the shell opposite the point where liquid will be at the desired height, or is elevated enough to maintain that height, Fig. 1. The float is so set that any rise in the evaporator level closes the valve, and any lowering of the liquid opens it.

In the second method practically all liquid refrigerant in the system stays in the evaporator, the float valve being employed to keep the receiver drained of refrigerant, Fig. 2. Control is arranged so that the float rises and opens the valve, when liquid level in the float chamber increases: the float thus regulates flow of the high-pressure refrigerant to the low-pressure side of the system. This method is, however, adaptable only to systems having one evaporator. With multiple evaporators the first method must be employed. In adapting the second control method, plant must be charged with the proper quantity of refrigerant to care for greatest load. Excess refrigerant is likely to cause wet compressor operation. A smaller charge is usually required than with the first method. The float can be installed above the receiver, and close enough to the coils to make insulation on the liquid line either unnecessary or of little consequence.

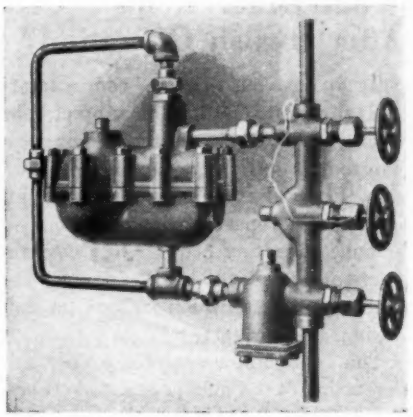


**Fig. 2—Inverted float passes all liquid into evaporator, keeps receiver empty**

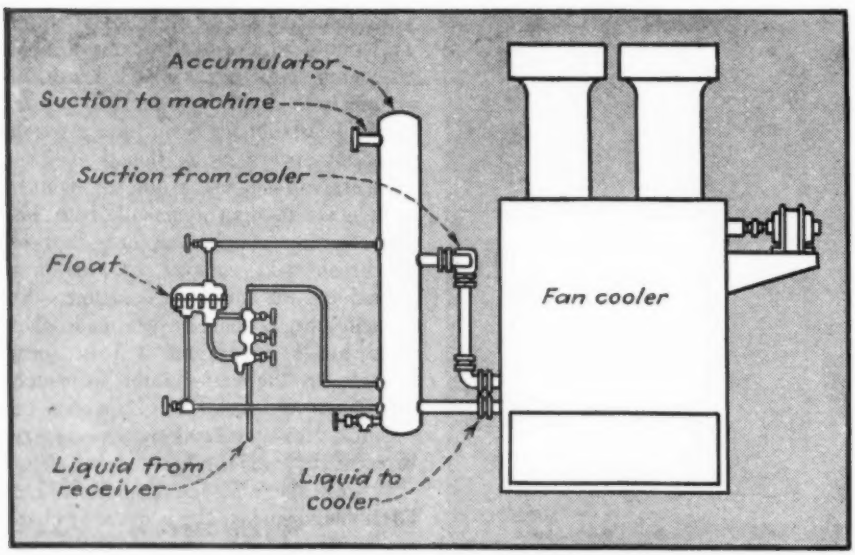



**Fig. 1—Float mounted at correct position maintains sufficient refrigerant in evaporator to prevent coil starvation and wet operation of the compressor**

In plants where liquid ammonia is precooled at high-suction pressure in a flash drum, the float valve used to control liquid flow into the ice-tank evaporator or other cooler is arranged to operate at a low pressure differential, and hence has a larger seat opening.

In general, float control keeps the evaporator flooded to a predetermined level all the time. Being independent of other conditions, such as temperature or pressure, it automatically permits operation at the highest possible suction pressure, and at maximum efficiency.

Cooling of the coils in rooms and boxes after starting is more uniform and rapid. After the compressor stops, when temperature and shutdown period permit, defrosting occurs naturally. On many jobs an accumulator is still used to keep frost off the machine cylinders: when the float control is built into it, this device is a "float-accumulator."

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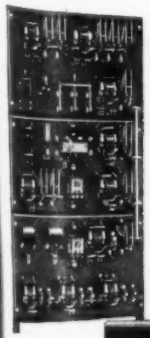

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# Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

# 10—*Boiler Construction, Cleaning and Inspection*

***Tenth in a series that is running in every number of* POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment—its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the oldtimer's knowledge, helps all comers pass engineer examinations and win certificates of higher grade. Besides being invaluable as a study course for examinations, it is a good review for the chief himself who wants to do a better job.—Editor***

*Q 1—What is the common form of manhole opening in flat surfaces?*

A—It is usually elliptical and flanged *inward* from solid plate, Fig. 1. When plate edge is less than $\frac{1}{8}$ in. thick, gasket bearing surface is increased by shrinking a narrow ring around the flange and facing off both ring and plate edge to form a smooth joint.

Elliptical manholes must not be less than 10x16 in. or 11x15 in. inside. Circular manholes must not be less than 15 in. inside diameter.

*Q 2—What is common form of manhole in curved surfaces?*

A—It is usually elliptical, with long axis at right angles to the axis of the shell, and is reinforced by a flanged ring riveted to the shell, Fig. 2. A ring is also shrunk around the flange of the reinforcing ring if more gasket bearing surface is required.

*Q 3—How are manhole cover plates and yokes made and what materials are used in their construction?*

A—Manhole cover plates and yokes are made from rolled, forged or cast steel for pressures over 250 psi and temperatures above 450 F. Below this temperature and pressure they may be made from cast iron.

The cover plate in Fig. 1 is made from steel plate. The bolts are riveted to the plate, and the yokes or dogs are cast steel or pressed steel.

The cover plate, Fig. 2, is also pressed from steel plate but the bolt heads fit loosely in slots instead of being riveted solidly to the plate. There is no possibility of leakage past the bolt heads with this construction, and probably less liability of bolt breakage, but the riveted bolt manhole cover is more easily handled, and does not often give any trouble.

*Q 4—Why are manholes and handholes usually elliptical in shape?*

A—The elliptical cover plate can easily pass through the manhole when it is necessary to take it out or insert it in place. This shape of manhole also affords easy access to the boiler with the minimum area of opening, and so does not weaken the plate to the same extent as openings of larger area.

*Q 5—Sketch a handhole opening and handhole cover plate.*

A—These sketches are shown in Fig. 3 at bottom of page.

*Q 6—What type of gasket is used on manhole and handhole cover plates?*

A—An asbestos gasket, molded to the correct shape, is commonly used. It should not be over $\frac{1}{4}$ in. thick when compressed.

*Q 7—How would you replace a manhole cover plate after washing out a boiler?*

A—It is not always necessary to replace the gasket, as a good one may be satisfactory after the joint has been broken several times. However, if there is any doubt that the gasket will make a tight joint, it should be discarded for a new gasket.

After cleaning off the joint faces, place the new gasket on the plate and smear the face of the gasket with a paste made from graphite and cylinder oil so that the joint will break readily the next time the boiler is opened. Insert the plate through the manhole opening. Hold it in place with one hand while positioning the yoke, screwing on the nut with the other hand.

(*Continued on page* 122)

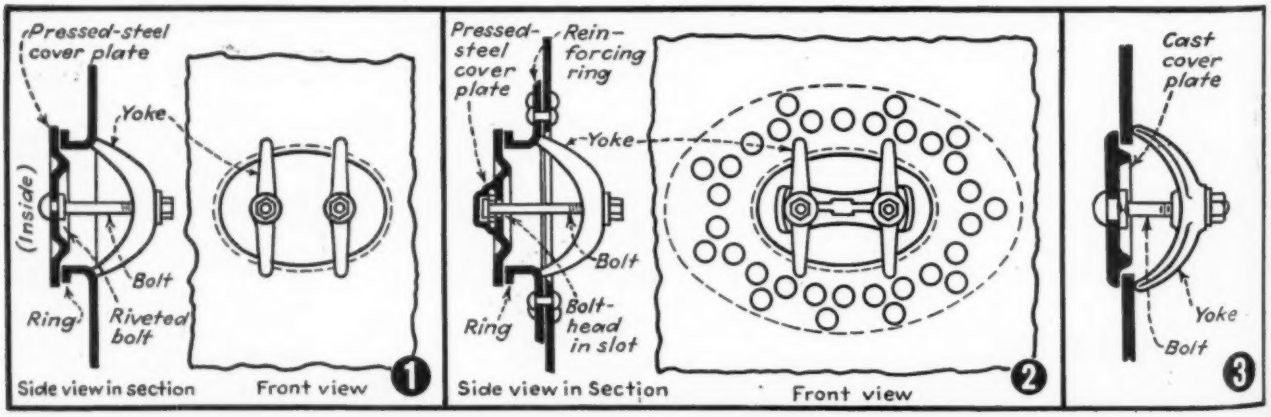


**Fig. 1—Manhole flanged from solid flat plate. Fig. 2—Manhole in curved surface. Fig. 3—Handhole and cover**

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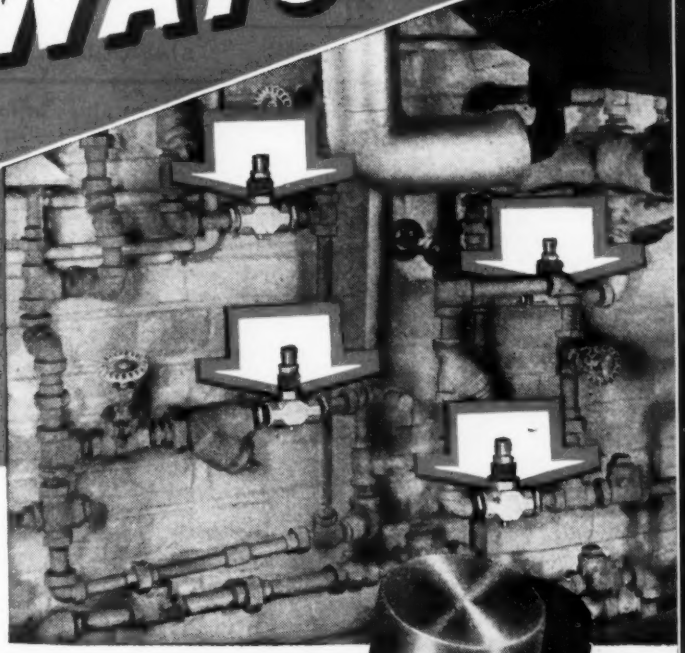

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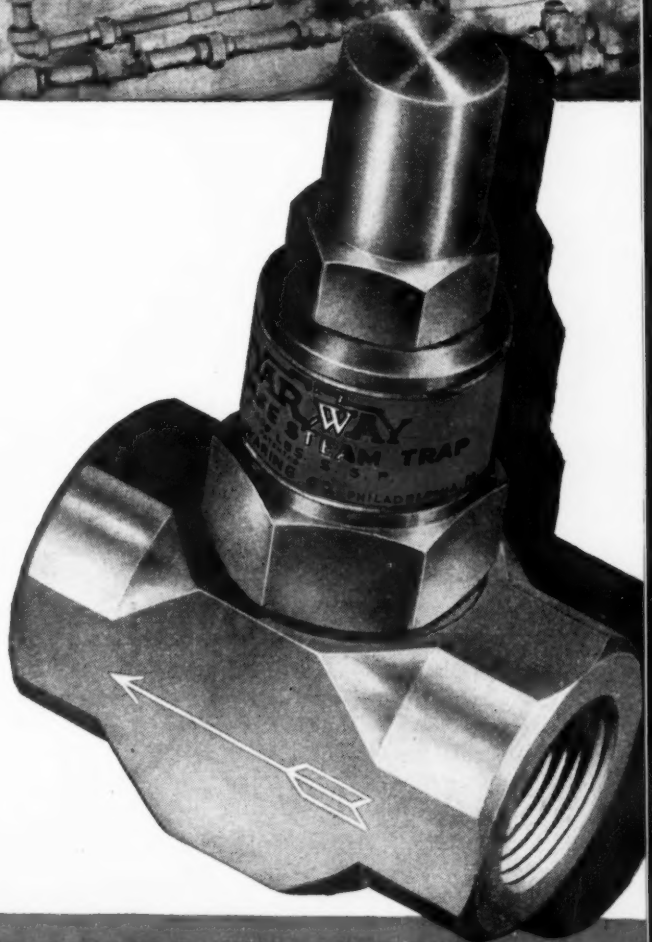


# YARWAY IMPULSE STEAM TRAP

# Q&A FOR POWER ENGINEERS

(*Continued from page* 120)

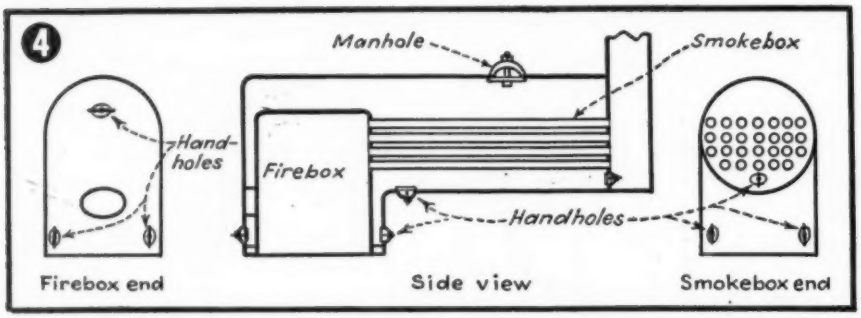


**Fig. 4—Position of handholes or washout plugs in locomotive type boiler**

Then put second yoke on, if two are used, and tighten both nuts, making sure that the plate remains central in the manhole opening and that the gasket has not shifted. Large manhole covers in the ends of horizontal drums are sometimes supported on hinges inside of the boiler head. These covers are not removed when the boiler is opened up but simply swung back clear of the opening.

*Q 8—Show, by sketches, the number and arrangement of washout plugs or handholes in a locomotive boiler.*

A—This boiler should have not less than six handholes or washout plugs, located as in Fig. 4: One in the rear head below the tubes; one in the front head in line with the crownsheet; four in the lower part of the waterleg and, when possible, one near the throat sheet.

Handholes should be at least $2\frac{3}{4}$x$3\frac{1}{2}$ in. and washout plugs not less than 1-in. pipe size. But larger sizes are desirable as the purpose of these openings is to permit visual inspection of the interior of the boiler and the insertion of washout hose and cleaning tools. Plugs of brass, bronze, or other non-ferrous metal may be used where pressures are not over 250 psi. They can be removed more easily than steel plugs and are less likely to corrode or rust in place.

*Q 9—How are threaded connections attached to boiler shells?*

A—When the plate is fairly thick and the threaded opening is *very small*, the plate is not greatly weakened by the hole, so the pipe is simply screwed into the plate. If the opening is large and the plate too thin for a strong and leakproof threaded joint, a reinforcing pad may be riveted or welded to the shell and a continuous thread run through both pad and shell plate. Attachment of a blowoff pipe to a hrt boiler by this method is shown in Fig. 5. All such connections may be seal welded either inside or outside the shell, though this is not particularly desirable in the blowoff pipe connection, which may have to be renewed frequently.

For boiler pressures over 100 psi, the maximum size of threaded pipe connections is 3 in.

*Q 10—Sketch several acceptable types of boiler-nozzle construction.*

A—In Fig. 6 *A*, the nozzle is riveted to the shell. *B* shows a nozzle attached by studs screwed into the shell plate, *C* a plain nozzle, welded to the shell plate, and *D* a welded nozzle with loose flange.

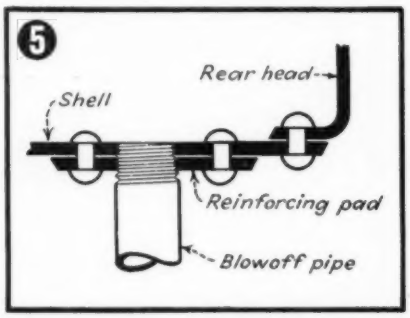


**Fig. 5—Blowoff attached to hrt boiler**

*Q 11—What defects would you look for when making an internal inspection of a steam boiler?*

A—After the boiler has been thoroughly cleaned, examine all plates, tubes, rivets, bolts, stays and internal fittings for signs of corrosion, cracks, breakage or distortion of shape. Cracked stays or rivets may be detected by tapping the parts lightly with a hand hammer, there being a decided difference between the ringing sound given off by a cracked part and one that is not cracked. Corrosion is indicated by an eating away of the metal surface, and a great number of fine cracks may indicate "embrittlement."

*Q 12—What defects would you look for when making an external inspection of a steam boiler?*

A—Such inspection should include the setting as well as the boiler proper, unless the boiler is self-contained. If the boiler has an external setting, examine it for cracks or other signs of deterioration in the brickwork, particularly in the refractory lining of the furnace. Carefully examine the supporting columns, bolts and beams to see whether they are sound. Outside of shell and all attachments to it should also be examined closely for signs of corrosion, cracks or breaks.

Carefully check parts subjected to intense heat for signs of burning, blistering or bagging of plates because of weakness in the metal or overheating by accumulations of oil, scale or mud on the water side of the plate. Where any part of a boiler shell or attachment to the shell is concealed by a brick or

(*Continued on page* 158)

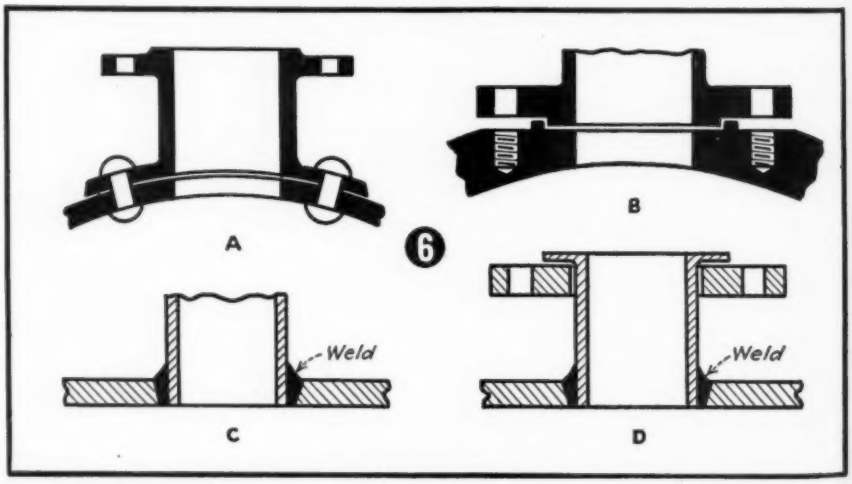


**Fig. 6—*A*: nozzle riveted to shell; *B*: nozzle attached to shell by studs; *C*: Plain nozzle welded to shell plate; *D*: Welded nozzle with loose flange**

# SOLNUS OILS

# *Give Carbon the "Brush-Off"*

## stop stuck rings and "forced shutdowns"

Bad carbon formations . . . stuck piston rings . . . forced shutdowns were the unwelcome visitors that insisted on making their headquarters in the diesel power plant of a certain eastern factory — until they were ousted by a Sun Oil Engineer and Solnus Oils.

**Frequent shutdowns delayed production.** Every three to six months carbon had to be removed. At these times the piston rings were so stuck that it was necessary to break them free . . . all this despite the fact they were using a supposedly high grade lubricating oil. So they called a Sun Engineer for advice. After studying the operating conditions he recommended Solnus Oil.

**16 months without a shutdown** was the record run as soon as the change to Solnus was made. Even then the shutdown was voluntary . . . for routine inspection. It disclosed all rings perfectly free, and what slight carbon there was could be removed easily and quickly with a wire brush.

**Plant is now back on schedule** and their carbon problem is solved. Solnus Oils may also solve yours. If you want trouble-free diesel performance, investigate these lubricants that are low in carbon content, neutral in acidity, wholly distilled and durable. Write

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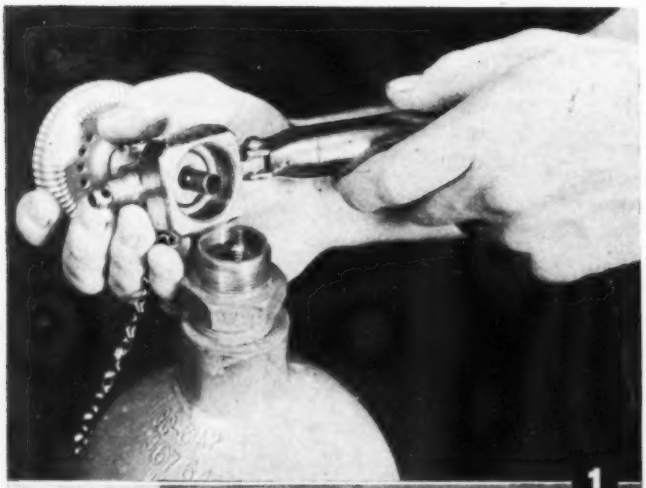
# HOW TO RECHARGE CARBON DIOXIDE CYLINDERS

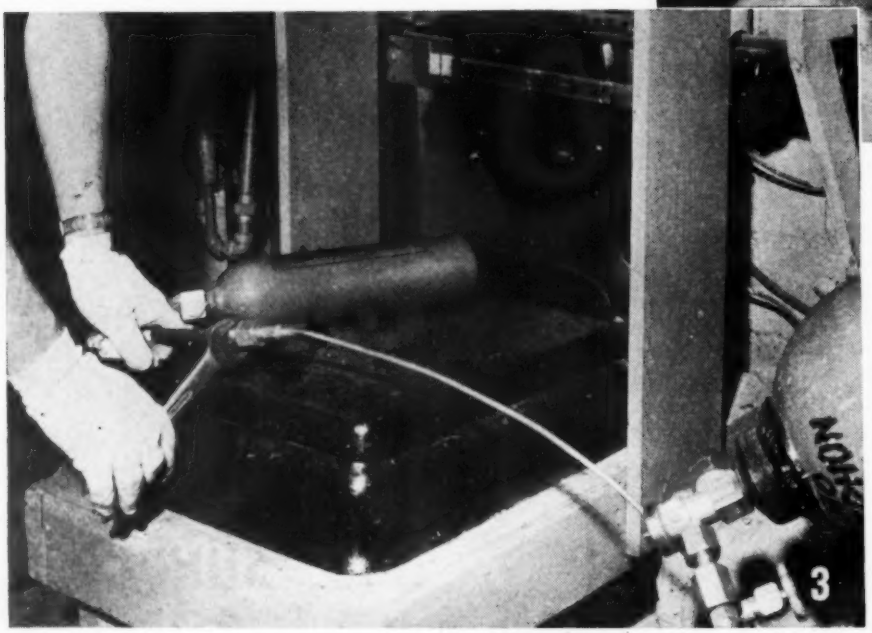


Liquid carbon dioxide can be transferred from a commercial cylinder to portable extinguishers by the cooling method. After cooling the extinguisher, stored pressure inside the commercial cylinder transfers required amount of liquid. Equipment needed: (1) piece of high-pressure tubing or hose with connectors (2) recharging bonnet and (3) blowoff valve.

*Photos, courtesy of Walter Kidde & Co, Inc*

**1** When recharging extinguishers equipped with disk valve, remove handwheel and cutter bonnet (left-hand thread) and with special wrench take out ruptured disk

**2** Insert a new disk bushing and screw it partly home. Leave special wrench in place and screw the charging bonnet on extinguisher nipple. Then back off disk-bushing wrench until it is tight against charging bonnet and tighten stem packing



**3** Lay extinguisher with its parts on the scales. (Weight stamped on nameplate band includes all parts.) Upend commercial cylinder (extreme right of photo) and connect the two with high-pressure tubing, as shown. Cool the extinguisher by introducing a small amount of carbon dioxide, then blowing it off. Repeat if necessary

(*Continued on page* 126)

# Full Steam Ahead, AMERICA!

IT has been estimated that 60,000 locomotives would be required to handle the volume of traffic now being handled by 39,000 if it were not for modern water treatment, much of which is being supplied by Nalco.

•

According to one authority 0.1 inch of scale in a boiler will cause heat losses as high as 15%. More than 4000 power plants using the Nalco System are eliminating such losses.

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Floating boilers can't take time out. A Nalco conditioned steamship recently set an all-time mileage record on the Great Lakes for one season.

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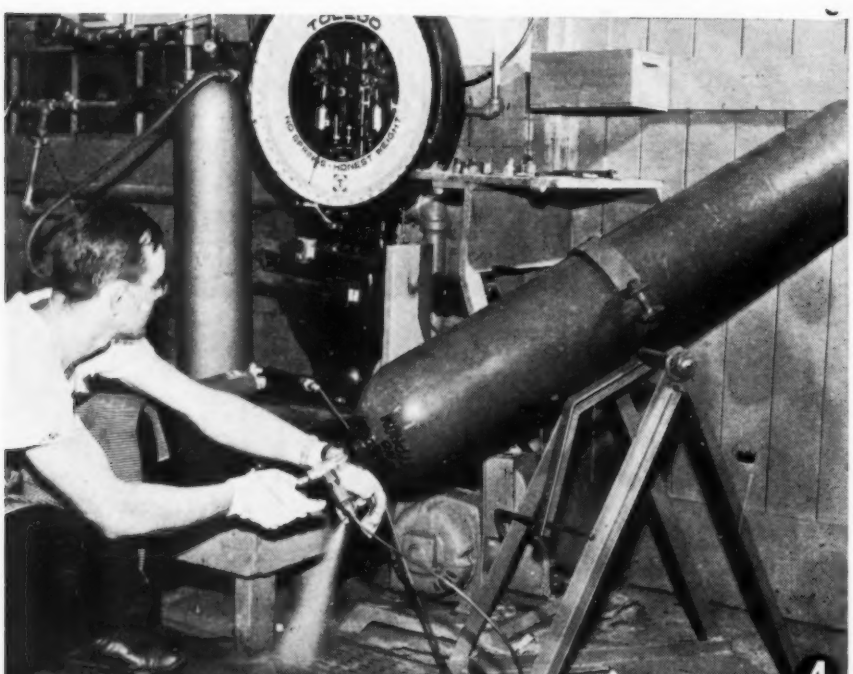
THE COMPLETE WATER TREATING SERVICE

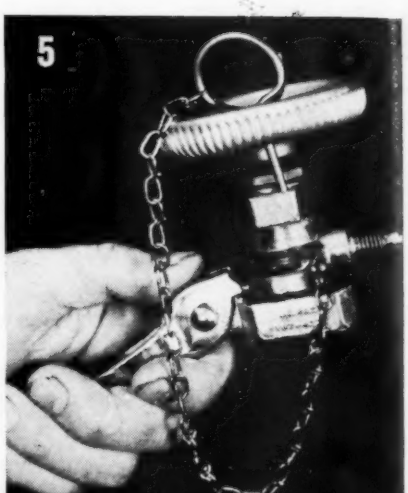
# HOW TO

## RECHARGE CARBON-DIOXIDE CYLINDERS

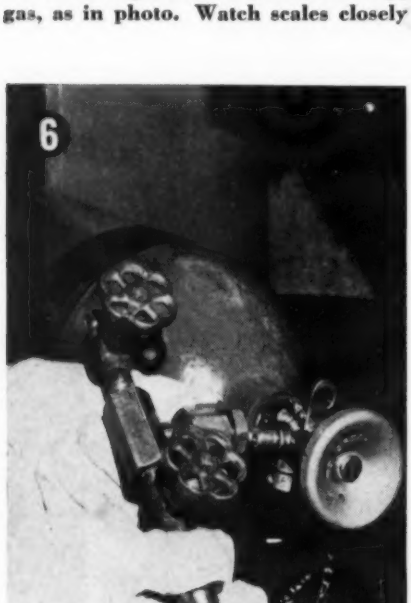
(*Continued from page* 124)



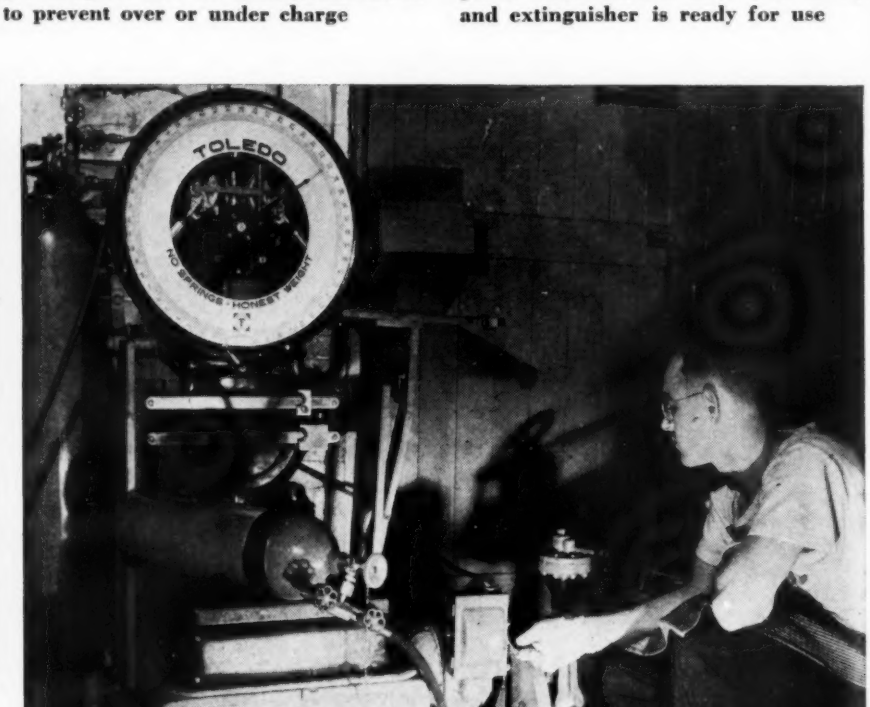

**4** Cooling creates a difference in temperature between the two cylinders, causing a pressure difference. Extinguisher being at lower temperature receives carbon dioxide from the warmer commercial cylinder. If flow stops before extinguisher fills, shut off supply and again blow off a small amount of gas, as in photo. Watch scales closely to prevent over or under charge



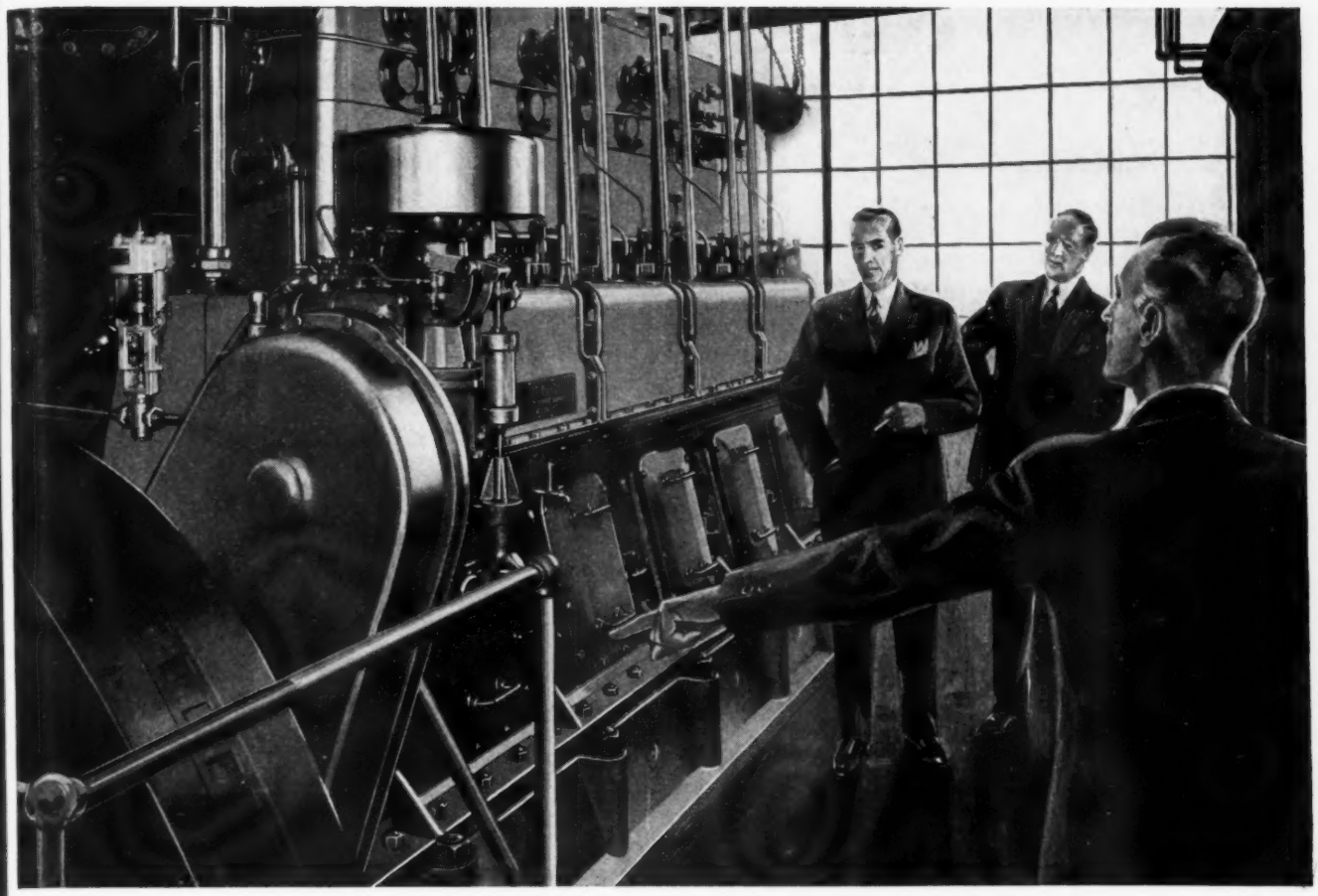

**5** When charging is completed close the supply valve, screw disk bushing to its seat and release pressure in tubing. Disconnect and remove recharging bonnet. Pour a little water on disk bushing to test for leaks. Rotate cutter valve up into its bonnet, as shown, insert locking pin and fasten the seal wire. Put valve bonnet on the extinguisher and screw tightly in place. Then attach hose and horn, and extinguisher is ready for use




**6** When recharging extinguishers equipped with seat valve, remove horn and hose and attach filling connector in place, as shown. Open extinguisher valve and proceed with recharging. After adding full charge, close extinguisher valve, disconnect filling manifold and re-attach hose




**7** Advantages of pump recharging (see photo) are: (1) Saves time when large number of portable units are recharged (2) Keeps gas waste to a minimum. (Cooling method always leaves some gas in commercial cylinder, and bleeding off to cool extinguisher causes considerable waste.)



# LOW COST, Dependable Power is Yours with a Baldwin Diesel

Your best insurance for an uninterrupted power supply in stationary service installations is a Baldwin Diesel Engine. Engineered and designed to meet individual requirements, Baldwin Diesels are answering many of today's production problems by providing low cost power in industrial plants throughout the nation.

Baldwin built the first commercially successful oil engine in 1893 and since that time has manufactured diesel engines for practically every application. The experience gained in countless diesel installations in central stations, cold storage plants, mills, mines, and public buildings is utilized in solving every new power problem.

Built in sizes ranging from 200 bhp to 1,500 bhp, Baldwin Diesels feature low maintenance cost, reduced fuel consumption, sturdy, simple construction, and unusual quietness of operation.

Every Baldwin Diesel Engine is put under a full load test and given a final check-up before leaving the shop to insure extra protection in every part. Consult a Baldwin engineer regarding your specific power requirements. The Baldwin Locomotive Works, Philadelphia, Pennsylvania, U. S. A.

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**BALDWIN**

**DIESEL ENGINES**

# ENGINEERS' BOOKSHELF

## Mathematics

MATHEMATICS FOR SELF STUDY (1931) *By J E Thompson, dept of math, Pratt Institute, Brooklyn, N. Y.—22nd printing. Published by D Van Nostrand Co, Inc, 250 4th Ave, New York. 5 vol. av 288 pages per vol, 5x7¾ in.; cloth binding, $8.95 set, or $2.00 vol.*

Here is a set for home study or for brushing up on applications of fundamental arithmetical operations for special work. Each volume contains practice problems with answers in back of book.

Volume one covers arithmetic starting with addition and following through on fractions; powers and roots; logarithms; ratio and proportion; common measures; time, temperature and angle measures; latitude, longitude and time; dimensions and areas of plane figures and volumes; graphs; percentage; and interest. It also has multiplication tables, squares and cubes, and common logarithms.

Beginning of volume two on algebra makes haste slowly so that fundamentals can be understood easily. Part 1 gives the student of algebra a new view of the familiar numbers and operations of arithmetic. Other chapters explain: laws of exponents, imaginary and complex numbers, powers and roots of binomials, equations, principles of logarithms, and exponential equations.

No mathematics beyond arithmetic and elementary algebra is required for studying the trigonometry volume. It teaches the solution of problems dealing with angles, giving functions and laws controlling these solutions.

Calculus volume includes such subjects as differentials of algebraic and trigonometric functions, interpretation of functions and derivatives by graphs, differentials of logarithmic and exponential functions, integral formulas and process of differentiation.

First published in 1934, the volume on geometry is written for those who wish to apply the principles to practical everyday work.

## Dramatic War Record

SCIENCE AT WAR—1943 *by George W Gray. Published by Harper & Brothers, 49 W 33rd St., New York, N. Y. 296 pages, 5½x8 in., cloth binding.* $3.00.

Scientist and engineer need not go outside their profession for romance and drama. This is another book that is "stranger than fiction" as it unfolds the exciting role science and engineering are playing in our all-out war effort and their part in social reconstruction to come. All scientific and engineering developments of the present conflict have not been recorded, because some are so vital that not even a hint of their nature has been released. It is possible, however, without violating any safeguards to review some of the contributions to the war effort. The book opens with the vivid story of the discovery of a magnetic mine, and of how a naval officer volunteered to attempt to open it. But, before doing so he left a report of each intended operation so that if the mine exploded his colleagues would have some idea what not to do if they tried opening another. Battle of Britain and the part that the radiolocator played in the successful conclusion of this decisive battle of civilization is another exciting tale. Bombs, torpedoes, rocket projectiles, airplanes, submarine chasers and spotters, electronics, medicine and surgery and many other subjects are presented in one great drama of science and engineering.

## Lubrication

LUBRICATION OF INDUSTRIAL AND MARINE MACHINERY—1943 *By William Gordon Forbes. Published by John Wiley & Sons, 440 4th Ave, New York, N. Y. 319 pages, 5½x8½ in., illustrated, tables, cloth binding.* $3.50.

Bearing lubrication is almost if not more important than the machine of which the bearings are a part, because without lubrication no machine can operate for long before burning out its bearings or doing more serious damage.

(*Continued on page* 176)


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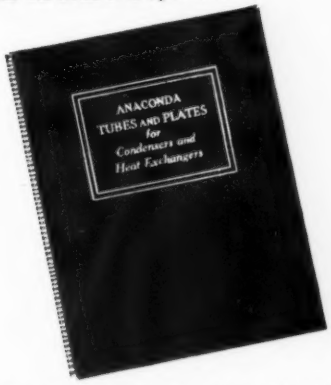
# NO GUESSWORK PERMITTED

Ross Heater and Manufacturing Company, Inc. BCP Tube Bundle. Navy Type for Sea Water Service. Anaconda Cupro Nickel Tubes and Tube Sheets. Brass Baffles Tie Rods and Spacers.

In the construction of costly engineering equipment such as heat exchangers and condensers, nothing should be left to chance. Considering engineering time, labor and materials and the consequences of unsatisfactory performance, guesswork is much too costly.

That is why manufacturers of this type of equipment confer with the Engineers of our Technical Department when it comes to selecting condenser tubes. Not only have these Engineers devoted years to the metallurgy of tube alloys, but also to the study of the complex conditions under which condenser and heat exchanger tubes must serve —such factors as the character of the cooling water, turbulent flow, excessive velocities and entrained air. Their suggestions and vast fund of experience have helped many tube users obtain maximum value.

4398




A wide range of tube alloys for condenser and heat exchanger installations is available from The American Brass Company. They are fully described in Condenser Tube Publication B-2, which will be sent on request.

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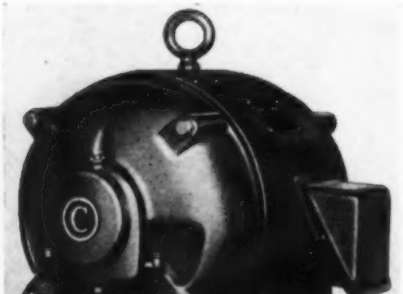
# WHAT'S NEW IN PLANT EQUIPMENT

## Dry-Type Transformers

LINE OF INDOOR transformers for primary circuits, 601 to 15,000 v, provides greater safety and ease of installation than previous designs, according to manufacturer. A radical departure from screened inclosure of older models, new design employs sheet steel, which is lighter in weight than screened inclosure. In addition, case provides improved and directed circulation of cooling air. Horizontally louvered sections on two sides of case can be removed easily, making interior accessible for cleaning and tap changing. *General Electric Co, Schenectady, N. Y.*



## General-Purpose Motor

FORM J open-rated motors, in 1½- to 15-hp sizes, have upper half of end bracket closed to minimize possibility of dripping liquids or falling solids entering vital motor parts. Two fans behind bearing brackets draw cooling air through bearing-bracket openings, around bearings, across windings and to air passages between outer surfaces of magnetic core and frame. Heated air expelled through openings at side and bottom of frame. *Century Electric Co, 1806 Pine St, St. Louis 3, Mo.*

## Luminaire

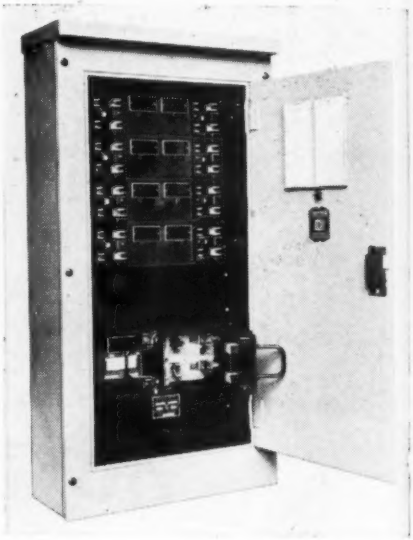
DOUBLE-REFLECTOR continuous-strip FNC luminaire for four or six 40-w or four 100-w Mazda F lamps. Hood fabricated from sheet steel with all ballasts, lamp holders and starter sockets mounted and wired as part of channel assembly. New sliding hangers permit suspension from any part of hood. Moisture-resistant non-metallic reflectors covered with multi-coat polymerized finish which provides a reflection factor of 85% or more, according to maker. Wing lock permits easy removal of reflectors for cleaning. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

## Insulation-Resistance Meter

ELECTRONIC insulation-resistance meter measures resistance of insulation in apparatus during manufacture and also checks condition of apparatus insulation in service. Consists of an electronic rectifier, Thyrite bridge circuit and electronic-tube voltmeter. Two meters available: One has a scale calibrated from 1 to 50 megohms and measures resistance at 500 v dc; the other has a 0 to 20,000 megohm total range over four different resistance intervals—from 0 to 5 megohms at 0 to 250 v dc and 5 to 200, 50 to 2000 and 500 to 20,000 megohms at 500 v dc. Range selected by a panel-mounted rotary switch. Meter may be used wherever 115-v 60-cycle current is available. *General Electric Co, Schenectady, N. Y.*

## Power and Lighting Panels

COMBINATION PANELS meet either low or high shock specifications of U. S. Navy. Panel shown built to meet low shock requirements; has eight 2-pole 30-amp lighting circuits and two 2-pole 60-amp power circuits. Box is dripproof. *Square D Co, 6060 Rivard St, Detroit, Mich.*



## Oil Tester

PORTABLE SET tests insulating liquids, such as oil and Pyranol, in industrial plants, central stations, substations and wherever frequent oil testing is required. Set provides variable test voltage from 0 to 30,000 v on single-phase 115- or 230-v, 25- or 60-cycle circuits. Single unit combines step-up trans-

(*Continued on page* 198)

# NEW TRAINING FILM FOR MAINTENANCE WORKERS

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TRAINING new workers in the fundamentals of piping maintenance becomes an easier task with this "Piping Pointers" sound film. It quickly familiarizes trainees with various types of valves and fittings and explains how to choose the most practical equipment for each use. It shows what to do when valves leak—how to handle many other maintenance problems—how to conserve time and critical materials. One complete section is devoted to the "*Language of Piping.*"

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# CRANE VALVES

# Little Sacrifice, Big Complaint . . .

"The people in this country who are making the greatest sacrifices are complaining the least", said Speaker Sam Rayburn (Texas) before the House of Representatives on December 9, 1943, in a widely acclaimed talk showing the pitfalls in our present thinking. He pointed out that current scare rumors about England and Russia (and how they will trick us when the time comes for deciding upon a world of tomorrow) are actually baseless. Said he: "Every day or every week somebody, somewhere asks: 'What are we going to do about England after the war; what is going to be done with this little island or that little island?' That is dangerous talk. It is a reflection upon the intelligence of American manhood and womanhood — that we do not have patriotism enough and brains enough to sit around a peace table with anybody upon the face of the earth." On the fear that Russia is going to communize the world, he said: "This form of government of yours and mine is not going to be changed until the people, exercising their intelligence and an unpurchasable ballot, vote to change this form of government."

To describe our general attitude he continued: "Ceilings for the other fellow but not for me; price fixation for the other fellow but not for me; uncontrolled inflation on what I have to sell, but controlled prices on what I am called upon to buy—that just will not work.

"I am wondering what sacrifice I have made, and I cannot think of a single one. I have had all the coffee I needed to drink and plenty of sugar to go into it. I have had enough gasoline to transact my essential business. I have eaten well and plenty, as has every other American citizen, and many have eaten better today than they have ever eaten before. Of course I have bought some bonds, but that is not sacrifice. I will get my money back with interest.

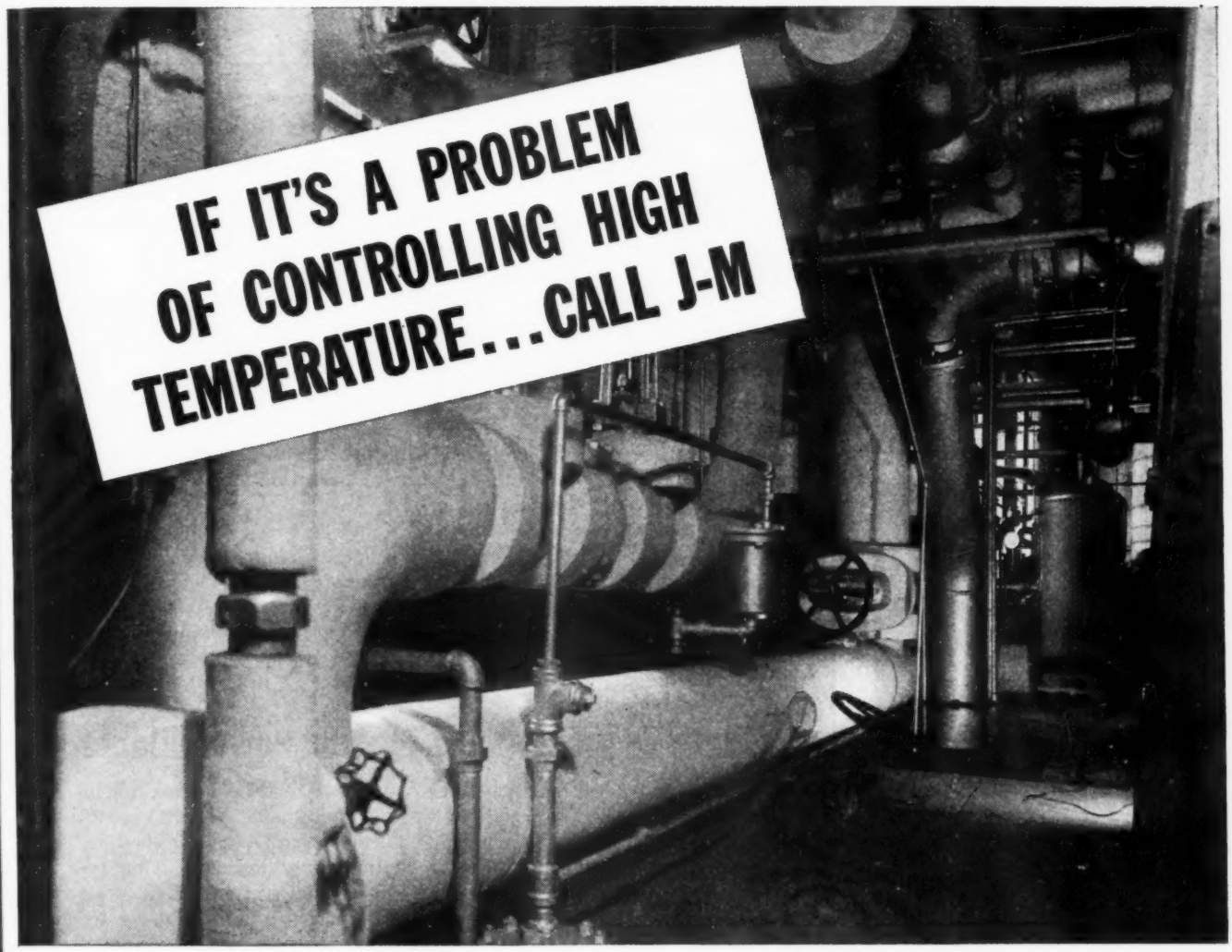
"We in this country would not know a war was on if we did not read the newspapers, hear the radio, and see the vacant chairs in the homes. Some people are complaining who have improved their positions during this war. Some people just love to be unhappy."

Concluding, Mr. Rayburn said:

"This war is not over by a great deal. The people of the United States are so geared that if we win a little island somewhere they think the war is almost over. But I cannot see anything in this situation, either in Europe or in Asia, that would counsel me to believe it is going to be a short war. We cannot look back. The very state of civilization depends not only on how our Army and our Navy act, but how you and I act and how you and I respond to the necessity of this hour. Unity in this war effort we *must* have!"

There is plenty for every one of us to think about in these words.

George Edwards
***Engineer***




# There's a J-M Insulation to do the job with utmost efficiency and economy

IT doesn't matter what your heat-control problem may be, there's a J-M Insulation made to solve it. Back of this ability to meet every insulation need is experience . . . 85 years of it . . . in every conceivable type of insulation work. That's why J-M Engineers can design insulation applications for special conditions with utmost speed, thoroughness and economy. Listed here are but a few of the many types of J-M Industrial Insulations.

**FOR TEMPERATURES TO 2600° F.** J-M Insulating Brick and Insulating Fire Brick are available in 7 types, with temperature limits ranging from 1600° F. to 2600° F. All provide light weight, low conductivity.

**FOR TEMPERATURES TO 1900° F.** J-M Superex Blocks have long been standard for this service. High heat resistance, low thermal conductivity. Sizes 3″ x 18″, 6″ x 36″ and 12″ x 36″, from 1″ to 4″ thick.

**FOR TEMPERATURES TO 700° F.** J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, high salvage and resistance to abuse are essential. For temperatures over 700°, used in combination with Superex. It is available in 3-ft. lengths, from 1″ to 3″ thick, for standard pipe sizes.

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For details on these materials, and on the complete J-M Insulation line, write for Catalog GI-6A. Johns-Manville, 22 East 40th Street, New York, 16, N. Y.

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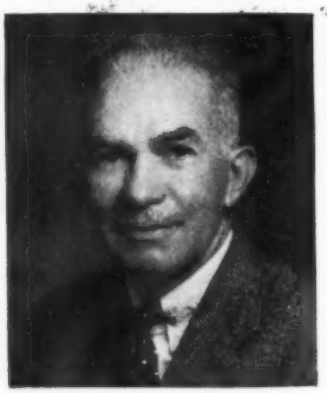
# POWER LINES

**Personal notes, items of general interest, the latest from Washington — all the news that is news in the power field**

## Japs Release Engineer From Shanghai Power Plant

Arriving in New York on the Gripsholm on December 1, 1943, with about 1500 other repatriates from Jap dominated territories, J K Rummel, chemical engineer, told POWER editors a unique story of power-plant operation in Shanghai, China, under Japanese control.



**J K Rummel, American chemical engineer in Shanghai until Sept, 1943, tells POWER editors unique story**

From March, 1935, to Sept 17, 1943, he was chief chemist and chemical engineer for the Shanghai Power Co of the American and Foreign Power Co, with headquarters at the Shanghai power station. Throughout this period he had charge of all chemical laboratory and chemical engineering work for the company, including fuel sampling and analysis, metallurgical studies and boiler feedwater treatment.

In 1939, circling the globe on furlough, Mr Rummel had stopped off in New York to visit POWER's editorial offices. Back on the Shanghai job in November of that year, he sensed the dangers of the growing international tensions, but stayed on as did the other Americans, British and Europeans holding executive and supervisory positions with the company.

Dawn of Dec. 7, 1941, found Pearl Harbor a smoking ruin. Before the same rising sun could circle east to Shanghai, the residents of the Chinese metropolis were awakened by the shelling of the British gunboat "Petrel." The

(*Continued on page* 180)

**Nearly 4000 engineers** have volunteered for service in behalf of the Bureau of Mines' fuel efficiency program and new enlistments are pouring in daily, Secretary Ickes announced recently. Designed to minimize wasteful practices in the use of coal, coke, wood, petroleum and gas as part of the Government's **critical resources conservation** campaign, the program is being organized by a National Fuel Efficiency Council with cooperation of the Bureau of Mines.

o o o

**Electrical Conservation Shorts** Pabst Brewing Co, Milwaukee, Wis., gave the program a boost in all cities where it maintains plants by ordering all its **signs darkened,** including those bearing the company's name. Only exceptions are building signs that read **"Buy War Bonds,"** etc.

First copy of **"Conservation Chatter,"** TVA's bi-weekly bulletin, shows newspaper publicity, including news and feature stories, slogan boxes, streamers and ads, from Knoxville, Memphis, Chattanooga and other cities. Pictures show streets before conservation was driven home and after the lights were actually out.

The Rochester, N. Y., Brewers Exchange voted not only to **eliminate all outdoor lighting** but also the 2-hr allowable period for advertising lighting.

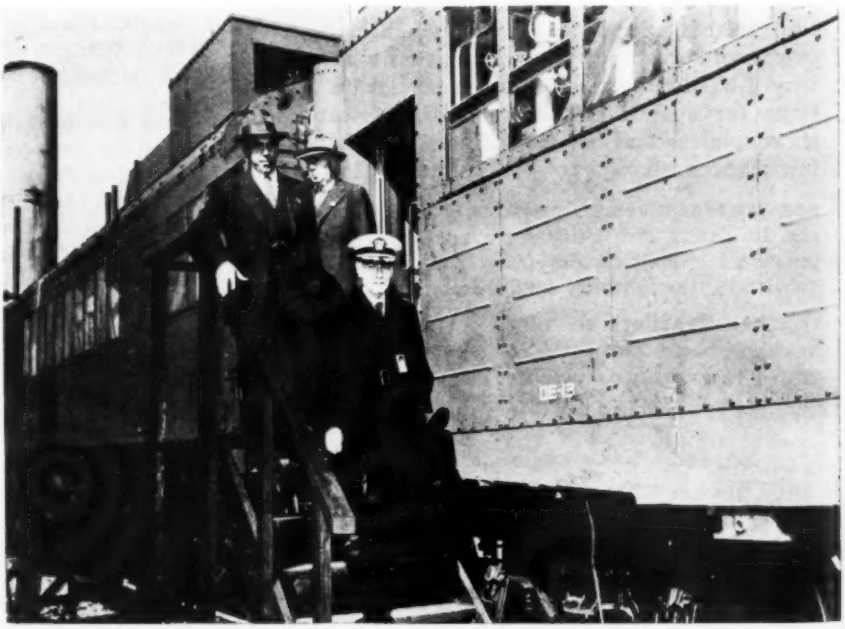
## Navy Inspects New Mobile Power Plants

Newest weapons for dealing knockout blows to the enemy are two mobile railway-car power plants of 20,000 kw electric-generating capacity. First of their kind (See Power, Jan 1942, p 67.) the units will supply power quickly wherever the Navy requires it. Detailed design was developed by General Electric under supervision of the Navy.

Each plant, consisting of a 3-car unit and comprising a complete 10,000-kw steam-electric generating station, can be hauled over the rails at speeds up to 40 mi per hr. Units are unique, but the apparatus is the same as in many central stations and industrial plants.

Plants can be "put on the line," it is estimated, within 24 hr after they are shunted into a siding. Boilers are fired by Bunker C fuel oil, and a sufficient supply is carried for 2-hr operation so that power can be generated before tank cars are hauled up and connected.

Generation is at 13,800 v and a transformer provides other voltages that correspond to the voltage of the existing electric distributing system at any naval shore establishment that needs a unit.



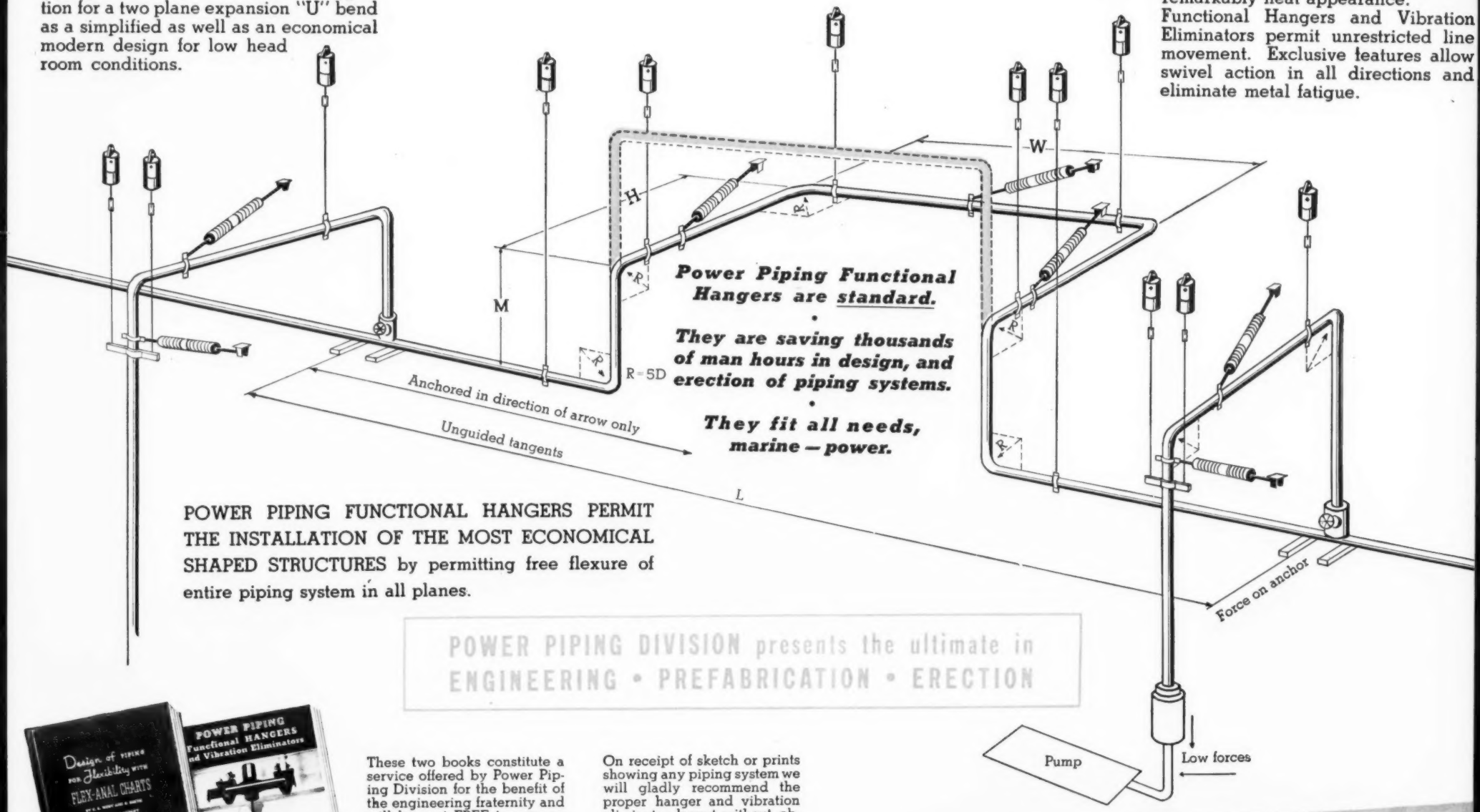
POWER LIFTING SERVICE IS YEARS IN ADVANCE

# POWER PIPING SERVICE IS YEARS IN ADVANCE

One example of "Scientific Approach to Piping Problems," illustrates a suggestion for a two plane expansion "U" bend as a simplified as well as an economical modern design for low head room conditions.

Spring assemblies are all of the same length at the same elevation away from interconnecting piping, valves, covering, etc., presenting a remarkably neat appearance.

Functional Hangers and Vibration Eliminators permit unrestricted line movement. Exclusive features allow swivel action in all directions and eliminate metal fatigue.




***Power Piping Functional Hangers are standard.***

•

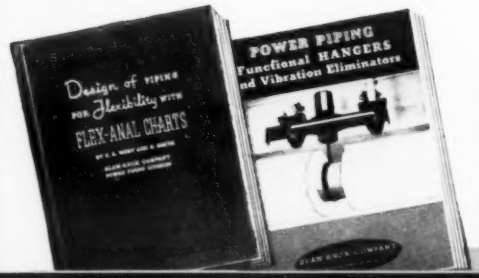
***They are saving thousands of man hours in design, and erection of piping systems.***

•

***They fit all needs, marine — power.***

POWER PIPING FUNCTIONAL HANGERS PERMIT THE INSTALLATION OF THE MOST ECONOMICAL SHAPED STRUCTURES by permitting free flexure of entire piping system in all planes.

POWER PIPING DIVISION presents the ultimate in
ENGINEERING • PREFABRICATION • ERECTION




These two books constitute a service offered by Power Piping Division for the benefit of the engineering fraternity and will be sent FREE to any engineer requesting them on his business letterhead.

On receipt of sketch or prints showing any piping system we will gladly recommend the proper hanger and vibration eliminator layout without obligation.

**BLAW-KNOX COMPANY**
**POWER PIPING DIVISION**

# *Prevent* Valve Failure

## VICIOUS CIRCLE of WEAR and WASTE

### —begins when you choose the Wrong Disc for the Service

When a valve is put in service with an incorrect disc, the "vicious circle" of trouble begins – premature disc wear, valve leakage, valve damage by "wire drawing" effect, sometimes complete valve destruction.

Since Globe, Angle, and Check Valves of the Renewable Composition Disc type are the most widely used of all valves, and since they are used for such a variety of services, the necessity of proper disc selection to keep them operating at top efficiency cannot be over emphasized. The proper disc assures tight closure, even though the valve is ordinarily subject to frequent operation.

Careful choice of discs is of first importance today because strict conservation of mechanical rubber goods is required by WPB. Also, because the "vicious circle" of trouble caused by careless selection of discs extends into plant interruptions that may delay delivery of war goods.

Prevent all such needless valve failure before it starts... by using the correct valves and discs for each service... proper installation . . . by frequent, thorough inspection. Repair or replace worn parts in time to prevent valves from destroying themselves. Teach new workmen to detect the first signs of valve trouble and correct it without delay.

Jenkins engineers will give you any assistance you need in developing an effective program of valve conservation.

Jenkins Bros., 80 White St., New York 13, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.

The discs illustrated have been damaged or worn prematurely by use in services for which they were never intended. The disc holder, shown above, was also ruined beyond repair by the effects of continuous leaking – the result of using an improper disc.

When a disc must be replaced, always examine the seat in the body before reassembling the valve. If there is any evidence of pitting or erosion, lap the seat until smooth with an emery cloth washer. If cuts have developed, dress the seat with a reseating tool, but only enough to restore a perfect seat.

# JENKINS VALVES

# before it starts!

## GUIDE TO CORRECT DISC SELECTION

For the duration, the manufacture of Jenkins Discs has been limited to the five compounds described here. These can be recommended for a complete range of service conditions.

As soon as conditions permit, we will resume the manufacture of Jenkins Composition Discs in a wider variety of substances – rubber, synthetic rubber, plastics and any other suitable materials to meet every degree of service.

| SERVICE | GLOBE, ANGLE, CHECK and Y VALVES | | |
|---|---|---|---|
| | PRESSURE RANGE | MAXIMUM TEMPERATURE | DISC NUMBER |
| SATURATED STEAM | 0# to 25#<br>25# to 150# | 267° F.<br>366° F. | 110-H<br>119-A |
| HOT WATER | 0# to 50#<br>50# to 1000# | 200° F.<br>300° F. | 110-H<br>119-A |
| COLD WATER | 0# to 300#<br>300# to 1000# | 115° F.<br>115° F. | 294<br>110-H |
| AIR and GAS | Vac. to 300#<br>300# to 600#<br>Vac. to 300# | Normal<br>Normal<br>200° F. | 294<br>110-H<br>294 |
| OIL | 0# to 150#<br>0# to 250# | 125° F.<br>250° F. | 936-A<br>119-A |
| GASOLINE | 0# to 300# | Normal | 936-A |
| OTHER SERVICES | Specific disc recommendations will be made on receipt of detailed service information. | | |

**No. 110-H. Semi-hard Disc for:**

SATURATED STEAM at pressures up to 25 pounds and maximum temperature of 267° F.

HOT WATER at pressures up to 300 pounds and maximum temperature of 250° F.

COLD WATER at pressures up to 1000 pounds and maximum temperature of 115° F.

AIR AND GAS at pressures up to 600 pounds and normal temperature.

Maintains tight seal within recommended pressure and temperature range. Satisfactory for air and gas service when oil is not prevalent in the line.

**No. 119-A. Hard Disc for:**

SATURATED STEAM at pressures up to 150 pounds and maximum temperature of 366° F.

HOT WATER at pressures up to 1000 pounds and maximum temperature of 300° F.

OIL at pressures up to 250 pounds and maximum temperature of 250° F.

Hard but sufficiently resilient to maintain tight seal within recommended pressure and temperature range. Very tough and dense in structure, with high flexural and impact strength. Will not crack, either while being fitted into holder or in service. Will not swell, creep, flake, fray, chip, distort, or delaminate in saturated steam or hot water; has very good resistance to oil. Satisfactory for acids of low concentration. Sufficiently alkali-resistant to meet practically all boiler feed-water conditions.

**No. 294. Medium-soft, Resilient Disc for:**

HOT WATER at pressures up to 50 pounds and maximum temperature of 200° F.

COLD WATER at pressures up to 600 pounds and maximum temperature of 115° F.

This disc is very tough, dense and enduring. It seals tightly the instant it is introduced into service and maintains tightness for long period within recommended pressure and temperature range.

**No. 936-A. Medium-soft, Resilient, Synthetic Disc for:**

OIL at pressures up to 100 pounds and maximum temperature of 125° F.

GASOLINE at pressures up to 75 pounds p.s.i. and normal temperature.

Has high resistance to lubricating and fuel oils, as well as benzol, gasoline and gas (including illuminating). Gives instantaneous tightness within recommended pressure and temperature range. Can also be used on air and gas service at low pressures and maximum temperature of 125° F., particularly when oil is present in the line.

No. 946-A. Synthetic disc similar in composition to No. 936-A, but slightly softer. Recommended for use on wide seating services under same conditions as No. 936-A.

## Select the *Right* Jenkins Disc from this New Wartime Chart

The above guide supersedes the chart shown on Page 386 of the Jenkins Catalog for the duration. Clip it out and keep it in your Jenkins Catalog for ready reference to discs now available.

Since square hole discs are no longer manufactured, round hole discs are regularly supplied. It is advisable to use the circular top disc nut in place of the square top nut when changing from a square hole to a round hole disc. Round hole discs have the advantage of uniform cross section and are secured with even pressure. Square hole discs have a tendency to crack if extreme care is not exercised in tightening the square top nut.

For every industrial, engineering, marine and power plant service

**BRONZE ★ IRON ★ STEEL**

Number 137

# Brush Operating Faults and Remedies—I

## PRIMARY SOURCES OF UNSATISFACTORY BRUSH PERFORMANCE

PREPARATION AND CARE OF MACHINE
1. Poor preparation of commutator surface
2. High mica
3. Feather-edge mica
4. Bar edges not chamfered after undercutting
5. Need for periodic cleaning
6. Clogged ventilating ducts

MACHINE ADJUSTMENT
7. Brushes in wrong position
8. Unequal brush spacing
9. Poor alignment of brush holders
10. Incorrect brush angle
11. Incorrect spring tension
12. Interpoles improperly adjusted
13. Series field improperly adjusted

MECHANICAL FAULT IN MACHINE
14. Brushes tight in holders
15. Brushes too loose in holders
16. Brush holders loose at mounting
17. Commutator loose
18. Loose pole pieces or pole-face shoes
19. Loose or worn bearings
20. Unequal air gaps
21. Unequal pole spacing
22. Dynamic unbalance
23. Variable angular velocity
24. Commutator too small

ELECTRICAL FAULT IN MACHINE
25. Open or high-resistance connection at commutator
26. Poor connection at shunt terminal
27. Short circuit in field or armature winding
28. Ground in field or armature winding
29. Reversed polarity on main pole or interpole

MACHINE DESIGN
30. Commutating zone too narrow
31. Commutating zone too wide
32. Brushes too thin
33. Brushes too thick
34. Magnetic saturation of interpoles
35. High bar-to-bar voltage
36. High ratio of brush contact to commutator surface
37. Insufficient cross-connection of armature coils

LOAD OR SERVICE CONDITION
38. Overload
39. Rapid change of load
40. Reversing operation of non-interpole machine
41. Plugging
42. Dynamic braking
43. Low average current density in brushes
44. Contaminated atmosphere
45. Acid fumes or smoke
46. Oil on commutator or oil mist in air
47. Abrasive dust in air
48. Humidity too high
49. Humidity too low

DISTURBING EXTERNAL CONDITION
50. Loose or unstable foundation
51. External source of vibration
52. External short circuit or very heavy load surge

WRONG BRUSH GRADE
53. "Commutation factor" too high
54. "Commutation factor" too low
55. Contact drop of brushes too high
56. Contact drop of brushes too low
57. Coefficient of friction too high
58. Lack of film forming properties in brush
59. Lack of polishing action in brush
60. Brushes too abrasive
61. Lack of carrying capacity

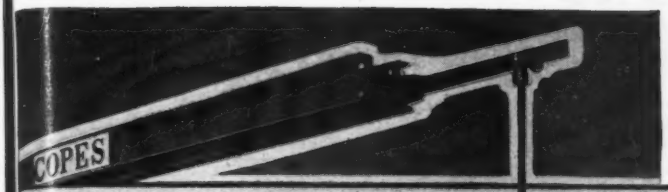
## INDICATIONS OF UNSATISFACTORY PERFORMANCE AND THEIR SOURCE

| INDICATIONS APPEARING AT BRUSHES | IMMEDIATE CAUSES | PRIMARY FAULTS |
|---|---|---|
| Sparking | Commutator surface condition | 1–2–3–43–44–45–46–49–58–59 |
| | Over-commutation | 7–12–31–33 |
| | Under-commutation | 7–12–30–32 |
| | Too rapid reversal of current | 7–12–30–32 |
| | Faulty machine adjustment | 8–9–11 |
| | Mechanical fault in machine | 14–15–16–17–18–19–20–21–22 |
| | Electrical fault in machine | 25–27–28–29 |
| | Bad load condition | 38–39–40–41–42 |
| | Poorly equalized parallel operation | 7–13–23–34 |
| | Vibration | 50–51 |
| | Chattering of brushes | *See "Chattering Brushes" |
| | Wrong brush grade | 54–56–58 |
| Etched or burned bands on brush face | Over-commutation | 7–12–31–33 |
| | Under-commutation | 7–12–30–32 |
| | Too rapid reversal of current | 7–12–30–32 |
| Pitting of brush face | Glowing | See "Glowing at brush face" |
| | Embedded copper | See "Copper in brush face" |
| Rapid brush wear | Commutator surface condition | See specific surface fault in evidence |
| | Severe sparking | See "Sparking" |
| | Imperfect contact with commutator | 11–14–15–16–50–51 |
| | Wrong brush grade | 53–57 |
| Glowing at brush face | Embedded copper | See "Copper in brush face" |
| | Faulty machine adjustment | 7–12 |
| | Severe load condition | 38–39–41–42 |
| | Bad service condition | 46–47 |
| | Wrong brush grade | 56–60–61 |
| Copper in brush face | Commutator surface condition | 2–3 |
| | Bad service condition | 43–46–47–48–49 |
| | Wrong brush grade | 58–60 |

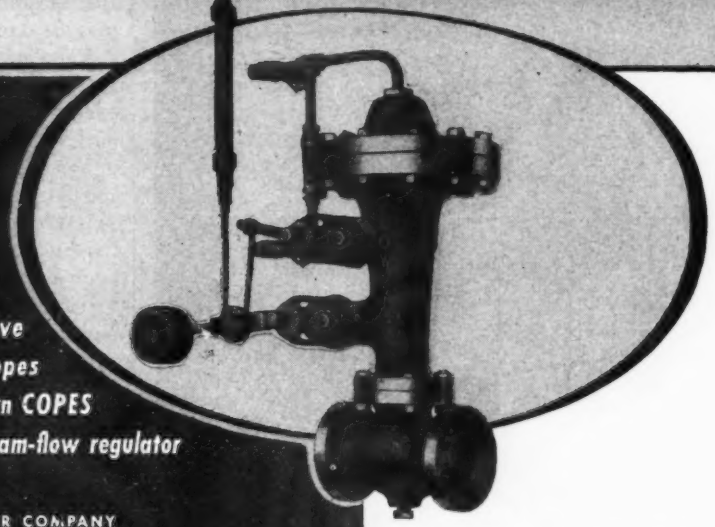
*Part II will appear in February POWER*

*Courtesy, National Carbon Co.*

© POWER




# PAY ONLY FOR MODERNIZATION CONVERT TO FLOWMATIC



*Just a few companies who have converted older Copes Regulators to modern COPES Flowmatic—the steam-flow regulator*

BARRETT COMPANY
BLANDIN PAPER COMPANY
DETROIT EDISON COMPANY
EASTMAN KODAK COMPANY
GARDNER-RICHARDSON COMPANY
STATE UNIVERSITY OF IOWA
JERSEY CENTRAL POWER & LIGHT COMPANY
JONES & LAUGHLIN STEEL COMPANY
NATIONAL CONTAINER CORPORATION
NEBRASKA POWER COMPANY
OTTER TAIL POWER COMPANY
PUBLIC SERVICE COMPANY OF COLORADO
PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS
PUBLIC SERVICE ELECTRIC & GAS COMPANY
REPUBLIC STEEL CORPORATION
SCOTT PAPER COMPANY
WHEELING STEEL CORPORATION
YOUNGSTOWN SHEET & TUBE COMPANY
DEWEY PORTLAND CEMENT COMPANY
TENNESSEE EASTMAN CORPORATION
SHELL OIL COMPANY, INC.

**THE cost of converting COPES Simple Level Regulators to Flowmatic, the 2-Element Regulator, has been kept to a minimum through sound basic design. As specialists in boiler feed water systems, it is our aim to make improvements readily adaptable to our thousands of COPES users.**

**The plants noted at the left are a few that have recently converted to Flowmatic—they paid only for the additional parts and service required.**

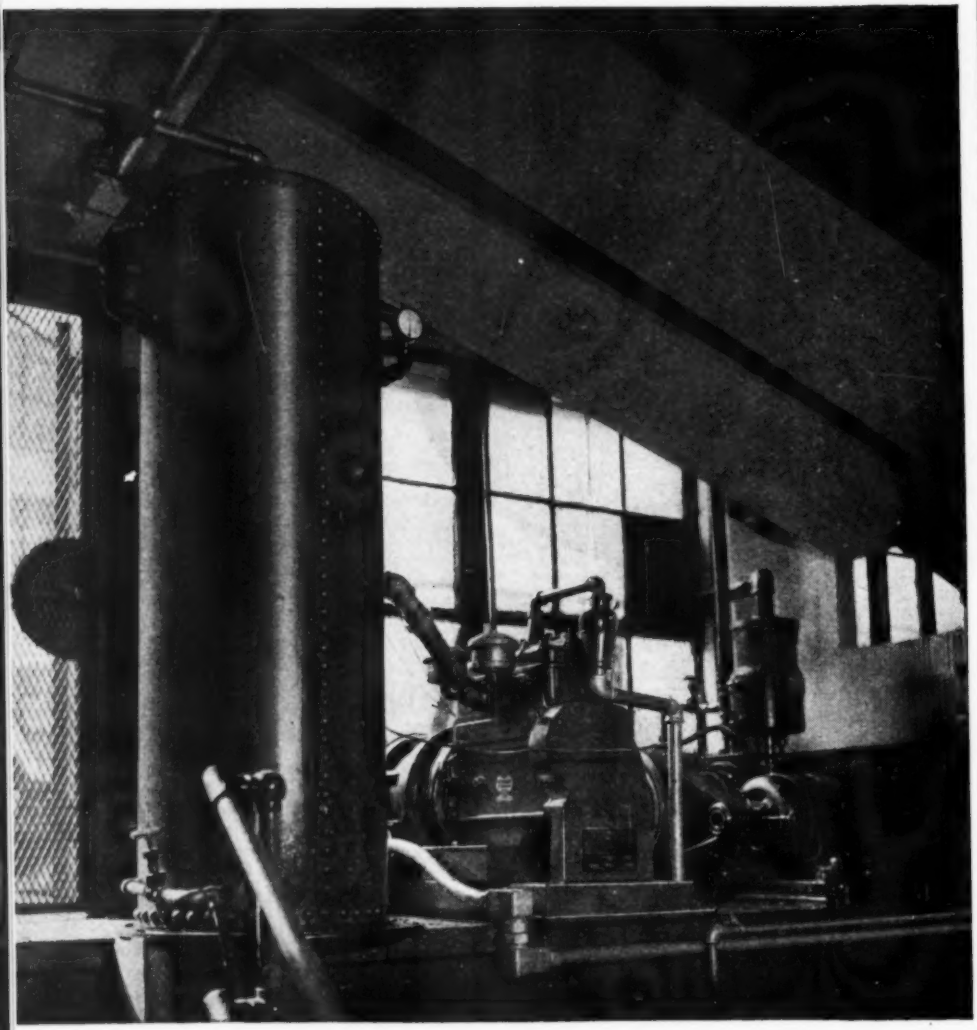
**The simple, sturdy, dependable COPES Regulator can either be made like new again or can be converted into a more modern type COPES unit. The scrap drive will never catch a COPES. If you are an old COPES user you will want to know how to convert to COPES Flowmatic. Write for booklet 429 that tells about Flowmatic, then we can talk about application or conversion.**

**NORTHERN EQUIPMENT CO • 141 Grove Drive, Erie, Pa.**
*FEED WATER REGULATORS • PUMP GOVERNORS • DIFFERENTIAL VALVES*
*LIQUID LEVEL CONTROLS • REDUCING VALVES AND DESUPERHEATERS*
**BRANCH PLANTS IN CANADA, ENGLAND REPRESENTATIVES EVERYWHERE**

OVER 60,000 COPES FEED WATER REGULATORS IN SERVICE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY FLOWMATIC ★ REGULATOR

# SCHRAMM COMPRESSORS ARE *BALANCED* TO ELIMINATE VIBRATION



HERE'S an installation showing just what can be done with an "easy-to-install," compact Schramm air compressor.

The unit represents a "utility" compressor directly driven from 20 HP Electric motor . . . installed on an ordinary wooden platform, which was made possible because of smooth, vibration-free operation.

Schramm compressors are available with various types belt drives, as well as built-in motor drive and direct connected diesel or gasoline engines. Other features that assure you plenty of air include: (1)—completely watercooled (2)—forced feed lubrication (3)—easy to start (4)—mechanical intake valve (5)—sturdy support for cylinder heads.

Specify Schramm Air Compressors in your plant and get heavy-duty continuous operation with least attention, upkeep and operating costs.

Write for full data in Catalog 42-S.

SCHRAMM INC. THE COMPRESSOR PEOPLE WEST CHESTER PENNSYLVANIA


## Packing Centrifugal Pumps

(*Continued from page* 72)

tern-ring. The plastic ring should have one ring of metallic packing between it and the bottom of the stuffing box and another ring of metallic packing between it and the lantern ring. Select plastic packing carefully because one that is suitable for the liquid pumped may be damaged by the sealing oil.

Regulate sealing-oil pressure in the lantern-ring by placing a differential or excess pressure valve on the inlet or outlet of the lantern-ring chamber, with an orifice valve on the other side to regulate the flow, Fig. 8. When the pressure-regulating valve is placed in the inlet pipe to the lantern-ring, any packing extruding into the lantern-ring will be carried away from this valve and not into it. With the needle valve in the outlet pipe to regulate flow, it can be opened to clear any obstruction that may lodge, and then be closed after it has cleared. Cut groove in orifice-valve to prevent its stopping all flow when closed. Place a pressure gage between the regulating valve and the lantern-ring, to show the pressure on the circulating system. A gage in the connection between the regulator and the pump casing will also assist in maintaining the correct differential pressure, if this is important.

Gas oil, alkylate or kerosene are often used for sealing liquids, but a light lubricating oil is preferable, except with a deadend system, Fig. 6, which often uses a steam cylinder oil. Sometimes, as a substitute for a sealing liquid, soft-soap or insoluble grease is injected into the lantern-ring periodically.

## ASRE Meeting

(*Continued from page* 77)

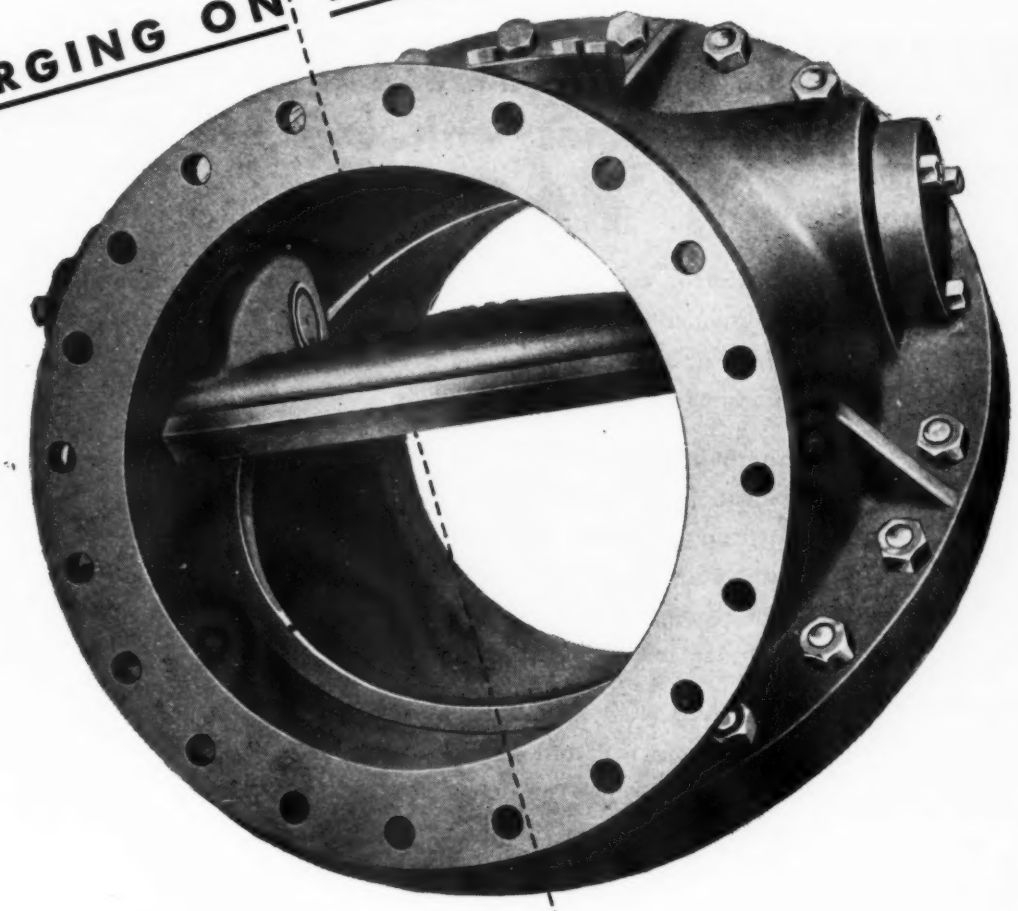
frozen and stored in the round and processed when desirable. Until this is done fish will always be restricted to a one-day market because the greater proportion of ocean fish sold today is nearly two weeks old when it is landed.

A B Stickney, engineer with Armour & Co, Chicago, Ill., was inducted as president, succeeding Charles R Logan of the Superior Valve & Fittings Co, Philadelphia, Pa., who has just completed a year as president of this rapidly growing group.

Other officers elected for the coming

# CUSHIONED CLOSING *Prevents*

## SLAMMING
## HAMMERING
## SURGING ON YOUR LINES



## ...with CHAPMAN *Tilting-Disc Check Valves*

Here's a check valve you can count on for *quiet* closing. Chapman's tilting disc is built on the airfoil principle, balanced and hinge-pinned so that reduction in the flow starts the disc closing until it comes down silently to a drop-tight seat. This cushioned closing cuts out slamming, hammering and opening of pipe joints because the disc *never* slams.

This exclusive design also gives you a reduction in head loss from 65% to 80% over conventional type checks... plus lower pumping costs that have saved as much as $95 per year per valve. If you want to see how to cushion costs on pipe lines and check valves, get the 12-page booklet that gives full engineering data, test results and installation information.

Write for your copy today to The Chapman Valve Manufacturing Co., Indian Orchard, Massachusetts.

## CHAPMAN NON-SLAM CUSHIONED CLOSING CHECK VALVES

THIS IS THE **3rd** of a series explaining why G-T PACKINGS give better service

The

# INVISIBLE LUBRICATOR

## that comes with each G-T PACKING

**8 REASONS for the Superiority of G-T Packings**

1. SIMPLE LINE . . . makes correct selection easy
2. COMPLETE LINE . . . an exactly suitable type for every service
3. SELF LUBRICATING . . . each individual strand saturated with lubricant
4. SPECIAL LUBRICANTS . . . lubricant for each service specially compounded in our own plant
5. SELECTED YARNS . . . provide tensile strength and resist high temperature
6. CONSTRUCTION . . . assures maximum endurance, longest life, lowest friction
7. EXPERIENCE . . . 80 years of manufacturing experience.
8. PERFORMANCE . . . proven in thousands of plants of every type

Whenever you pack a pump, compressor, engine, valve or other apparatus with a G-T Packing, you include a storage of lubricant in the stuffing box.

This lubricant is INSIDE the packing . . . placed there by the G-T exclusive manufacturing process. By this process, each individual strand of packing is impregnated with a lubricant specially compounded for the service.

G-T PACKINGS ARE SELF LUBRICATING and remain soft and pliable during their entire service life. They have reduced frictional wear of rods and shafts in plants all over the world. Standardize on G-T Packings . . . prevent wear of equipment . . . get longer packing life.

**GREENE, TWEED & CO.**
Bronx Blvd. at 238 St., New York 66, N. Y.

PALMETTO *for steam, hot water, air.* PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT **PACKINGS**

**G-T** *self-lubricating* **PACKINGS**


year are: *vice-president*—John F Stone, manager, refrigerating division, Johns-Manville, New York; *vice-president*—Charles S Leopold, consulting engineer, Philadelphia; *treasurer*—John G Bergdoll, Jr., chief engineer, York Corp, York, Pa.; *directors*—Dr Arthur W Ewell, Westinghouse consultant, Worcester, Mass.; Dr D K Tressler, food consultant, General Electric Co, Bridgeport, Conn.; Frank H Faust, engineer, air conditioning division, General Electric Co, Bloomfield, N. J.; Clifford F Holske, sales manager eastern area, Vilter Mfg Co, New York; William W Higham, chief engineer, Universal Cooler Corp, Marion, Ohio; George I Boone, manufacturer's representative, Tecumseh Products Co, New York.

## Governor Fundamentals

(*Continued from page* 87)

a valve were increased before the next valve started to open. Of course, an increased pressure drop also affects the unit's efficiency at valve-open position.

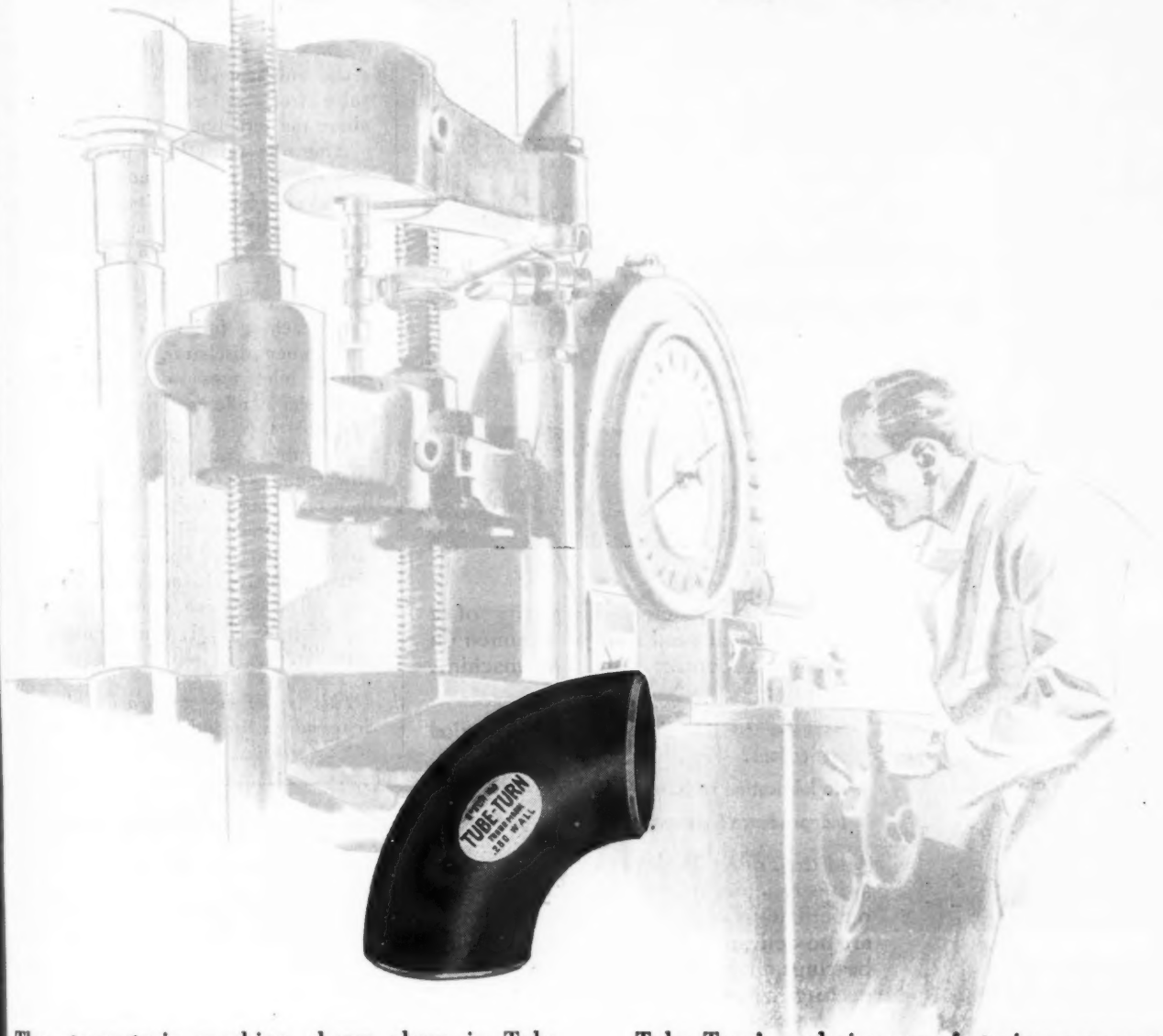
So far the governing valves have not helped the governor out any; as a matter of fact, the incremental regulation line of the valves, so far considered, shows considerable variation.

Plug valves with diffuser seat, in sufficient numbers, show the smallest deviation from a straight flow-travel line, curve *e*, Fig. 3C, D and E. Effect of uneven governor travel cannot be eliminated and, as far as the valves are concerned, minimum deviation from the governor line should give acceptable valve performance.

Another governing valve characteristic that must be considered, especially when it is operated by the governor directly, is the force required to move the valve through its operating range. Examination of Fig. 4C shows that this valve is not suitable for direct connection to the governor because full steam pressure tends to hold the valve on its seat. Considerable speed change must occur before the governor can build up power to lift the valve against this pressure; then, as soon as the valve lifts, steam pressure builds up underneath adding its power to that of the governor. The valve opens wide and then shuts, causing considerable change in turbine speed. So-called balanced valves, Fig. 4A and B, are better suited for direct connection to the governor, but even here the forces are not negligible, Fig. 5.

The zero line, through middle of curve represents balanced forces acting

# STRONG

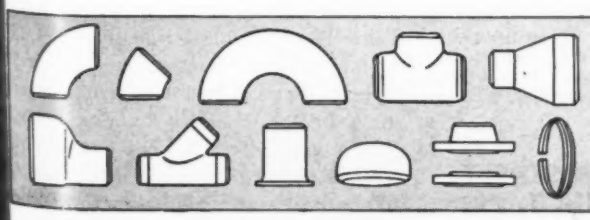



The stress-strain machine, shown above in Tube Turns' laboratories, scientifically records tensile strength.

Welding fittings *must* be strong. Stronger than pipe. For the greatest strain and vibration occur *at the fittings.* Strength is imperative against the high pressures, extreme velocities and corrosive wear to which fittings are subjected in many piping systems. Strong welding fittings help to hold leakage, breakdowns and consequent repairs to a minimum.

Tube Turn's exclusive manufacturing process produces *extra* strong fittings. Tensile tests on the stress-strain recording machine methodically *insure* the superior strength standards found in all Tube-Turn seamless welding fittings.

TUBE TURNS (Inc.) Louisville, Kentucky. *Branch Offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle . . . Distributors located in principal cities.



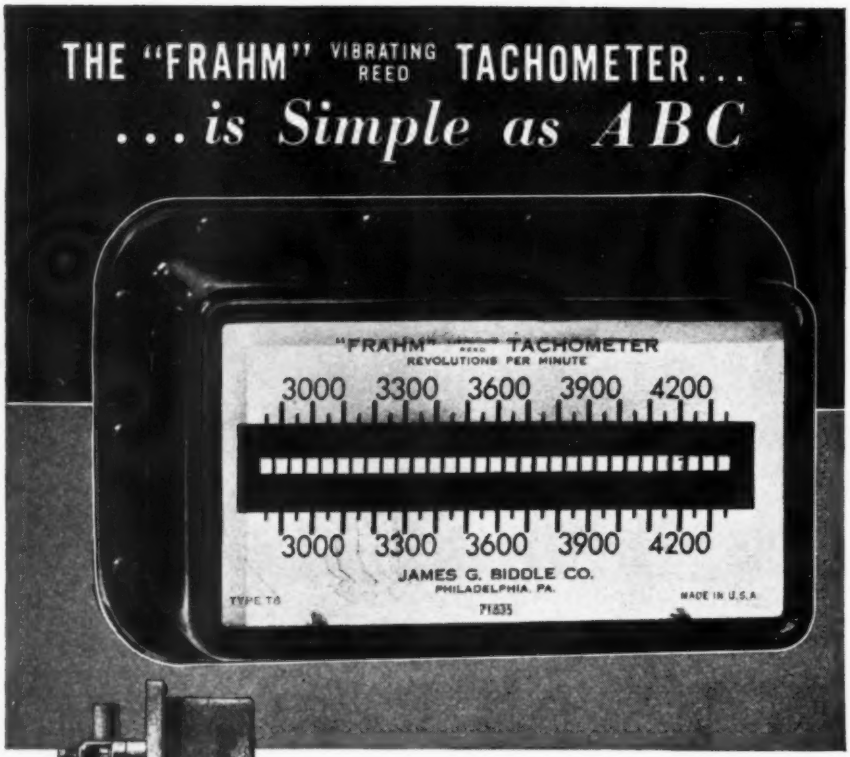
**TUBE-TURN**

TRADE MARK

*Welding Fittings and Flanges*

# THE "FRAHM" VIBRATING REED TACHOMETER...

## ...is Simple as ABC




*Above:* Showing one method of mounting the Frahm Tachometer.

*Below, left:* Frahm Hand Tachometer.

*Below, right:* Frahm Permanent Mount Tachometer.

Consider the inherent simplicity of a tachometer that need only be mounted on or held in contact with the machine. It means:

**No belts, flexible shafts, gears, or electrical connections.**

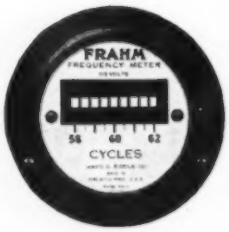
**No lubrication required; No maintenance.**

**Independence from any outside source of power.**

And the Frahm Tachometer is as accurate as it is reliable. It functions faithfully without attention year after year because there are no delicate parts—no springs, jeweled bearings, pivots, weights, magnets or connecting wires—nothing except a set of steel reeds, accurately calibrated and suitably mounted.

Furnished in stationary and portable types . . . for use on turbines, generators, motors, blowers, centrifugal pumps, Diesel-electric installations, etc. Various ranges available from 900 to 30,000 r.p.m.

*For a complete description of Frahm Tachometers, together with list of types and ranges commonly supplied, write for Bulletin 1590-P.*




**"FRAHM" VIBRATING-REED FREQUENCY METERS**—operate on the same unique principle as Frahm Tachometers, except that reed vibration is produced electrically instead of by direct mechanical contact. Unaffected by wave form or ordinary temperature changes. Switchboard, portable and miniature types in various ranges from 10 to 500 cycles per second. Write for Bulletin 1695-P.

**JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.**


on the valve and the governor has no difficulty in operating a valve with this characteristic. Actually, few valves even approach this line because the valve's lower-disk area is slightly smaller than the upper one as it must pass through upper seat when assembling. With steam between the upper and lower seats, unbalanced forces try to lift the valve from its seat, Fig. 5, starting above the zero line at *X*.

After the valve lifts, pressure drop and dynamic forces change the lifting to a closing force, with its highest value at approximately one-quarter total lift. From here on increasing pressure on the discharge side gradually changes the force curve to the opening direction, reaching full value at wide-open valve when discharge pressure nearly equals inlet pressure. Changing the valve shape affects force curve. It is advisable to use this control combination on drives where the no-load steam flow requires a valve opening greater than one-quarter travel; otherwise, the governor force-travel curve becomes so distorted that good operation is seldom obtained. Valve size and steam pressure generally determine whether the control scheme, Fig. 1, can be used successfully.

*This is the first of two articles. Mr Schwender's second article will appear in an early issue.*

## Correcting Steam Flow

(*Continued from page* 90)

design conditions, 4.1053, by the combined factor for actual steam, 2.4740, gives 1.6594: If the meter reads 5000 lb per hr, the actual flow would be 5000x1.6594 = 8297 lb per hr. (Check of the conventional formula method shows a flow of 8290 lb per hr, an error for the tables of less than 0.1%.)

Of course the change in volume due to superheat is not exactly uniform at all pressures. For the range of Table II, however, an average of eight pressure points has been taken that gives an average maximum error of ¼%.

Another common problem is that of correcting a measurement of flow from a given pressure and temperature to dry saturated condition at the same pressure. This can be done by using Table II, but Table III has been set up to facilitate the computation. Instead of a multiplying factor, the number of lb-per-hr to be *added* to a measured flow is given directly. For example, if 1000 lb per hr of steam is measured at 100-psi gage and 50-F superheat, the

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(PATENT APPLIED FOR)

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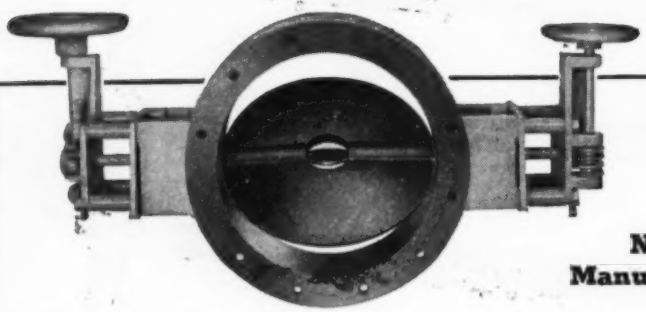
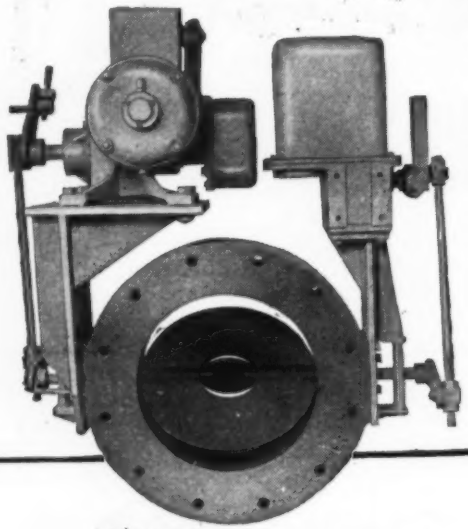
***Operates Beyond the Limitations of a Single Valve***



**No. 608**
**Manual Control**

Close control of volume and pressure can be obtained with this dual-purpose hand wheel operated R-S Butterfly Valve. The large vane seats against the body of the valve while the smaller vane is free revolving. Both vanes are hand wheel operated. Only four to six revolutions of a hand wheel are required for complete opening or closing.



**No. 583**
**Power Control**

**15 to 900 psi**

*Detailed information and catalog furnished upon request.*

VALVE DIVISION

**R-S PRODUCTS CORPORATION**

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R-S Streamlined BUTTERFLY VALVES


correction to dry saturated condition at the same pressure is found directly opposite 50-F superheat under 1000 lb per hr, as 40.0 lb. The corrected amount would be 1000 plus 40 or 1040 lb per hr. The same correction would, of course, apply for any quantity measured in any period of time.

Table III can be used for any quantity by shifting decimal point. For example, to calculate the correction for a measured flow of 5267 lb at 100-psi gage and 102-F superheat to dry saturated condition, obtain the following values from Table III opposite 102-F superheat:

| | | |
|---|---|---|
| 500..... | 38.93x10 | = 389.3 |
| 200..... | 15.57x 1 | = 15.6 |
| 600..... | 46.72x 0.1 | = 4.7 |
| 700..... | 54.50x 0.01 | = 0.5 |
| | | 410.1 |

and add the correction. Thus 5267 lb plus 410 lb or 5677 lb would be the flow on a 100-psi gage, dry saturated base.

If steam is to be measured at dry saturated condition and corrected to a condition of some superheat, simply divide the correction obtained from Table III by the superheat factor in the first column after the superheat figure and *subtract* the correction from the measured flow. Thus for 1000 lb at 100-psi gage dry saturated corrected to 50-F at the same pressure would involve a correction from Table III of 40 lb. Divide 40 by 1.04, the factor oposite 50-F superheat, to get 38.5 lb. Then 1000 lb minus 38.5 lb would be 961.5 lb actual flow under the superheat condition.

## Lubrication Specifications

(*Continued from page* 106)

vides better oils than are actually needed for some applications, the lubricant cost is increased only slightly, and number of lubricants are greatly reduced. This reduction lowers storage and lubricating-equipment costs, obviates confusion in lubrication application and decreases equipment failure and maintenance to an extent that soon pays for the slightly higher lubricant cost.

Lubricant specifications, as many POWER readers realize, represent a highly controversial subject. Therefore it may be well to state some of the common complaints which purchasers may hear if they are considering or buying lubricants on their own specifications. Following each complaint is an analysis

# SAVING POWER

## ALL ALONG THE LINE

Dodge-Timken Line Shaft Hangers saving power in the plant of Addressograph-Multigraph Company, Cleveland, Ohio. This plant is completely Dodge-Timken equipped.

OBSOLETE line shaft hangers and pillow blocks are prolific sources of power loss—and often are least suspected. Friction generated in plain bearing units is responsible for high power costs in many plants where out-moded transmission equipment is tolerated.

Such equipment is responsible for high lubrication and maintenance costs as well, for it consumes lubricant as fast as it is put in; what isn't burned up, leaks out —with the risk of further loss through product contamination. Rapid shaft wear resulting from direct frictional contact between shaft and bearing is still another factor of excessive cost.

These losses are prevented by modern Timken Bearing Equipped power transmission units, for friction is eliminated and with it all its satellites of waste. Have you checked your transmission equipment recently? If not it will pay you to do so now and to mark for the scrap pile every unit guilty of sabotaging production and profit. The Timken Roller Bearing Company, Canton 6, Ohio.

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of the problem as it was found to affect our situation.

1. *Since a strict set of lubricant specifications cannot include products of all manufacturers, oil salesmen usually find numerous and varied reasons for explaining why specifications cannot include all good lubricants nor exclude some inferior ones.*

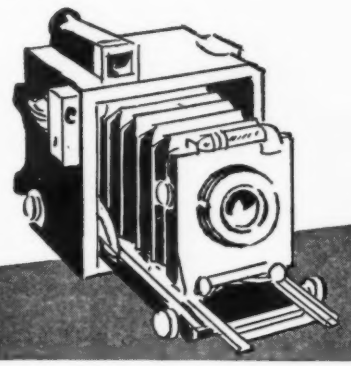
It is true that laboratory tests do not tell the whole story, and probably never will be quite as reliable as long-term plant tests. However, they do give a fairly good indication of refinement and care in manufacture and of the expected stability and life of lubricants, as well as an indication of life expectancy of the equipment they lubricate. Properly written, consumer's specifications give assurance of a high-grade product where such is needed and also insure uniform quality regardless of supply source.

Of course, chemical additives in lubricants have greatly complicated the situation since the relation between laboratory tests and service performance often does not hold for additive-type oils as it does for straight refined oils. New laboratory equipment and procedures are being devised to tell the service performance of these newer and more effective lubricants. So far, however, correlation between such tests and operating results is still rather inadequate and unreliable. It should be of interest, therefore, that we have made arrangements in our specifications (See note G-1, Table II.) to approve a superior lubricant even though it may not meet our laboratory specifications.

2. *It is often stated that only large plants, like those in the automobile industry, can afford to set up their own lubricant specifications and that such specifications are unsuited for any purchases of less than tank-car lots because of high cost of control analysis, handling, etc.*

It is quite possible that the cost of complete control of every drum of oil or grease going into a plant becomes prohibitive in proportion to the value of goods received. However, because of rather close control at the refineries, such diligence is usually not necessary. We have found that an occasional check-up of a sample from a certain lot number is sufficient. We have fairly complete lubricant-analysis laboratory equipment in several of our larger plants and these facilities are available to plants not so completely equipped. In all fairness it should be stated that the accurate analysis of lubricants requires considerable experience on the part of the analyst and that such quali-

# PUTS HEAT into steam units with the speed of a camera shutter



An ANDERSON SUPER-SILVERTOP STEAM TRAP, equipped with a snap-action Anderson Thermal Air Eliminator, puts heat into steam using units with the same click and speed as a camera shutter. Located on the side of the bucket (see diagram) the Eliminator is wide open when steam is first turned on, the pressure forces the air out of the exhaust in an instant, then the Eliminator clicks shut, preventing any steam loss. With air removed, the unit immediately fills with hot, dry steam and heating starts instantly. From then on the Steam Trap keeps the unit free from condensate and entrained air.

If you want instant heat in your steam using units, send today for the copy of the book, "How to Choose a Steam Trap," which gives complete details on ANDERSON SUPER-SILVERTOP STEAM TRAPS, equipped with Anderson Thermal Air Eliminator.

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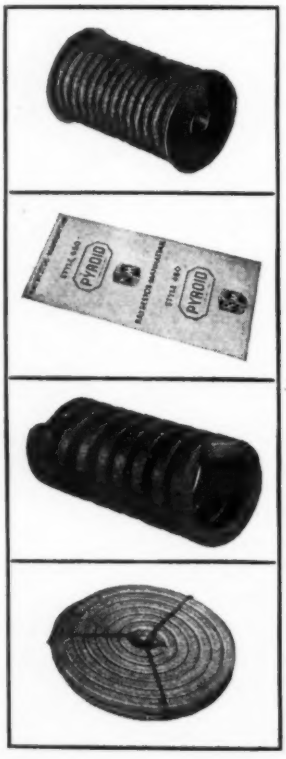
**1934 West 96th Street • Cleveland 2, Ohio**

**Super-Silvertop**
**•• STEAM TRAPS ••**

# Packing a WALLOP For Victory!

As equipment gets older in many plants, with little or no chance for replacement until the war is over, present machines, pipelines, and the like must be made to last. R/M packings are constituted to get the most *out* of old, over-worked steam, oil, fuel, and air lines by holding everything *in* them.



Awarded to R/M
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fication is rather difficult to find during these times.

3. *Purchasing departments and oil companies alike are apt to complain about the narrow limits in most lubricant specifications. This tends to decrease the number of brands available to the purchasing departments and also seems to discriminate against some well-known lines.*

In most cases, and ours in particular, this is a rather necessary evil. Most of our oils and greases are called upon to do double and triple duty to cut down confusion in their application. Our specification limits must be narrow in order to insure products which will meet the requirements of all the duties they are expected to perform. The products must be uniform in quality and characteristics, regardless of the supply source. As mentioned, a great deal of research was done on the specifications of available lubricants in order to have our limits wide enough to include as many of the desirable products as possible, yet narrow enough to assure our requirements positively.

Consumer's lubricant specifications must of necessity have the needs of their plants as primary consideration. It is doubtful if specifications will ever be written which will not slight some satisfactory lubricant in order to prevent the purchase of unsuitable ones. On the whole, the practice of buying lubricants on bids and consumer's specifications is not only advantageous to the purchaser. By eliminating the personal and emphasizing the quality-product angle, such specifications are probably the fairest means of establishing a sound consumer-supplier relationship.

*The author wishes to acknowledge the assistance of R M Strain and F J Bochnik of the Seagram organization and of Lt (JG) Czarnicki, now serving in our armed forces.*

## Readers' Problems

(*Continued from page* 117)

also be more carbon deposited in the slots before the brushes wear smooth.

*Westwood, Calif.* R G SUNDQUIST

## True up Commutator

WHEN SANDING commutator or collector rings, use only fine sandpaper, say, 2/0 or finer. Commutators and collector rings should be maintained concentric with the shaft and never be allowed to

It's just horse sense that a "horsepower" Steam Turbine sized right for the job saves metal for war and money for you while an "Elephant Power" Turbine too big for the job wastes both. COPPUS Blue Ribbon Turbines come in six frame sizes from 150 H. P. down to fractional. Each smaller size requires less metal and is priced less. The "Blue Ribbon" certifies prize-winning COPPUS performance.

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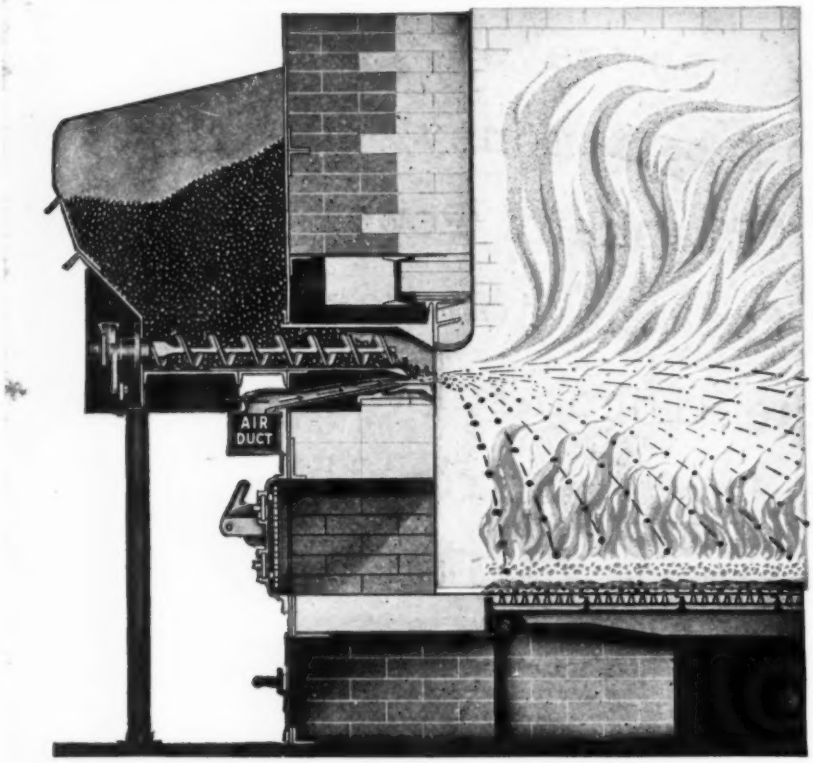
# Need more steam *Capacity?*




## USE FYR-FEEDER MULTIPLE-SPREADER STOKERS

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FYR-FEEDER STOKERS burn any kind and size of bituminous screenings or coal yard sweepings. FYR-FEEDER features: Suitable for large or small boilers . . . low maintenance . . . low power requirements . . . maximum active coal burning area (no dead plates) . . . easily accessible multiple feeding units . . . large coal hopper capacity . . . accurate over-fire air control . . . no clinkers . . . can be operated by anybody.

**WRITE FOR CATALOG** *and have an engineer make a survey of your plant, without obligation, to show you what FYR-FEEDER can do.*

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become eccentric. If a flat spot develops, true up the commutator or rings promptly as the brush face cannot maintain close contact with a surface of varying radius.

If the surface of the collector rings or commutator is true and polished the brush maintains close contact with it and arcing is kept to a minimum, other conditions being in order. The smoother the surface (without glaze) the less wear and trouble.

*Franklin, Ind.* I A BUTCHER

## Describes Sanding Rig

SANDING BRUSHES on the commutator is objectionable because carbon dust accumulates in the machine. Use a brush holder and steel ring about twice the width of brush and curved to same radius as commutator. This ring can be held in a vise.

First saw off one corner of brush, equal to brush angle, put it in holder and screw down spring tension to 1½ to 2 psi. Then with a long strip of coarse sandpaper take off enough carbon to give about three quarters area of brush contact and finish with fine sandpaper to a smooth surface. This makes a better contact than rough sandpaper although the process is much slower. Replace paper at intervals because it fills up quickly. Always pull it with machine rotation and release spring pressure on return stroke. If brushes are copper plated their edges should be slightly beveled so copper plating will not touch commutator.

ADP should not worry too much about which grade of paper fills with carbon faster than another. This filling up or plugging reduces the abrasiveness of sandpaper and must be watched; otherwise, the brush may be sanded to an angle with high and low spots.

Assuming commutator has been turned down with a lathe tool, mica undercut and commutator well sanded check the positive and negative brushes for stagger. This should be about half brush width to avoid high ridges on commutator. Now with brushes in position adjust upper spring tension with a scale to about 1½ to 2 psi, and slightly more on bottom brushes. Run machine at normal speed with no load and voltage for a few hours until brushes develop a slight glaze over their surface, checking brushes and commutator meanwhile for heating because frictional drag on newly turned commutator with new brushes is fairly high.

When fitting brushes on slip rings note whether flat spots or eccentricity of rings exist. Brushes for large current capacity rings made in pairs are slightly

# Did You See This News Item?

## 30% More Capacity—30% Lower Bill!

Here is a dramatic example of the ability of a bank of capacitors to solve an electrical problem for a busy factory. At the Paxton-Mitchell Co., iron foundry at Omaha, Nebraska, the power demand was 190 kva and the wiring couldn't carry the load properly. Power factor was only 70% but when 90 kva of capacitors were installed the same motors produced a demand of only 145 kva! It has been possible to connect more motors without adding to wire, main switch, fuse or transformer capacity; the cost of the capacitors which cured the low power factor problem will be paid out of savings in about 15 months.

8 ELECTRIFIED INDUSTRY, SEPTEMBER, 1943

## THE CAPACITORS ARE PYRANOL

To this story from *Electrified Industry* we'd like to add only two points. First, because capacitors usually do eliminate the need for extensive rewiring when they are put in to improve power factor (as was the case at this Paxton-Mitchell foundry), they thus save critical material, time, labor, and money. And, second, because Pyranol* capacitors are readily available and are easy to install, they represent today's ***quickest*** method of improving power factor.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, ask your G-E representative to estimate how much *your* circuit capacity can be increased by Pyranol capacitors. Or write for Bulletin GEA-77. *General Electric Co., Schenectady, N. Y.*

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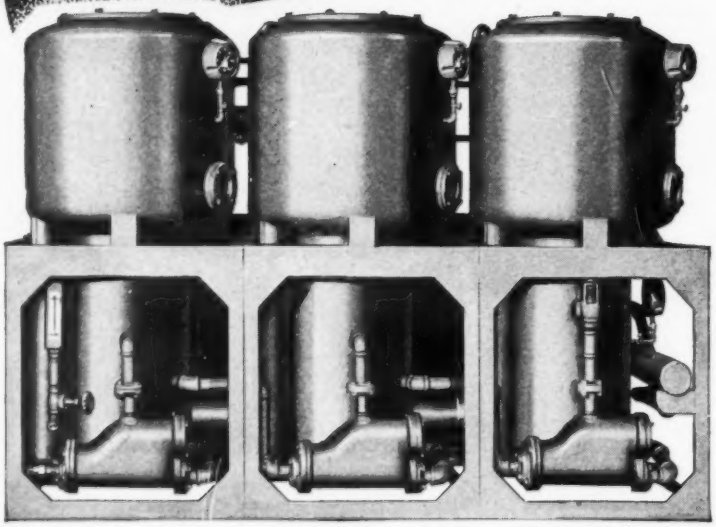

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staggered on the ring to prevent wearing a ridge between them. Several pairs per ring facilitate inspection while running and avoid the heavy spring tension needed on one large brush. Also, a pair of brushes adapt themselves much better to the ring surface than one large brush.

A brush may have cross-sectional area of 1 sq in. but its angle of inclination may produce a contact area of 1¼ to 1½ sq in. Current density in the brush surface may be less than in the body of brush because of its greater area.

*Ottawa, Ont.* JOSEPH BONGIORNO

## Coarse Paper For Hard Brushes

WHEN SANDING-IN BRUSHES, the exact grade of paper depends entirely on their physical characteristics. A coarser paper can be used for hard brushes than for soft ones. For the first part of the sanding-in process use the coarsest paper that will not damage the brush. When brush contact is nearly complete a fine paper should be used. For this final finishing it is best to move the paper only in the direction of rotation across the brush face, pressing the brush against the holder in that direction to take up any looseness and raising the brush from the paper for the return stroke. Brush spring tension can be increased to shorten the time of initial sanding, or pressure can be applied by hand. The brush face should be as nearly perfect in smoothness and contact as possible. Always avoid ridges of even small size.

The brush manufacturer will gladly furnish complete instructions for fitting and preparing particular grades for service, and should always be consulted in problems of this kind.

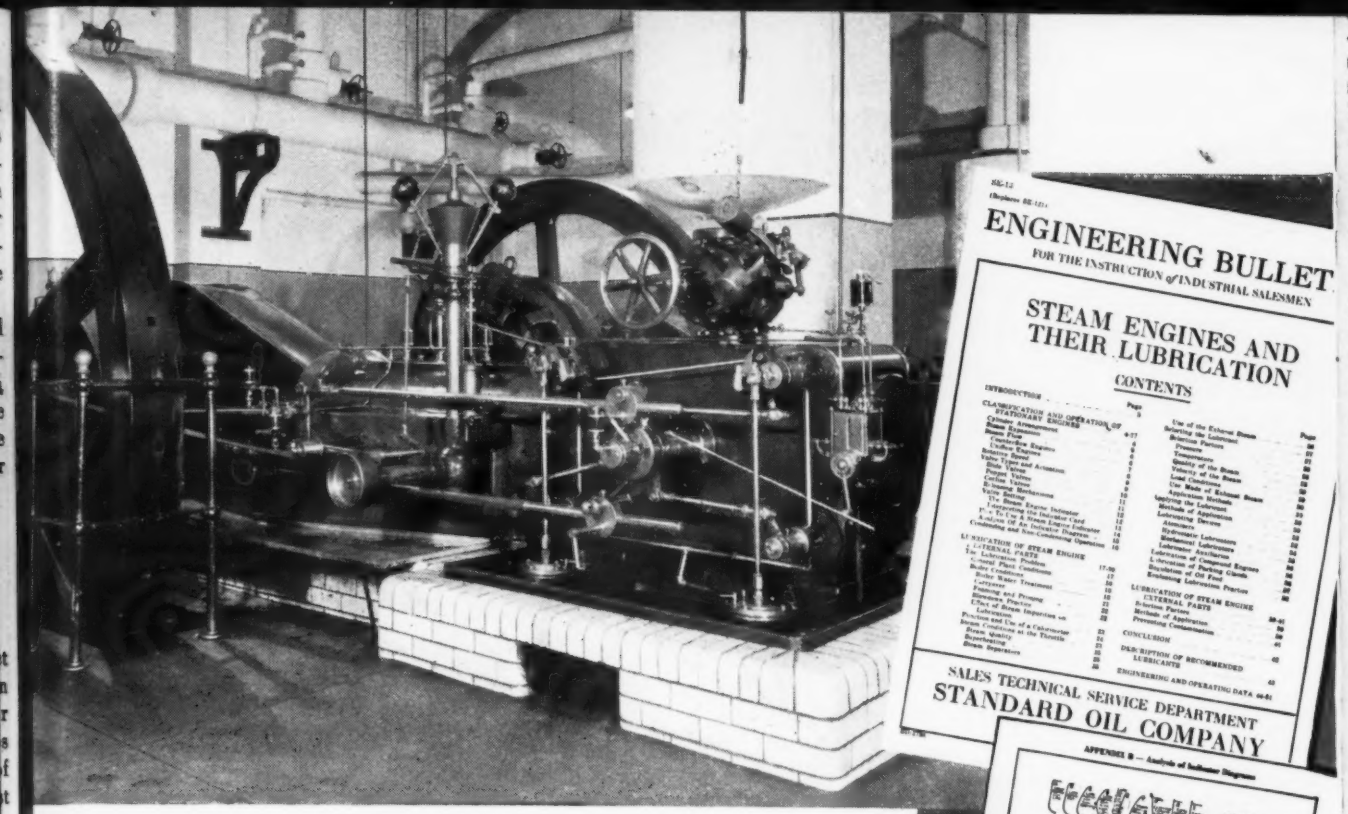
*Saint John, N. B.* C G CLARK

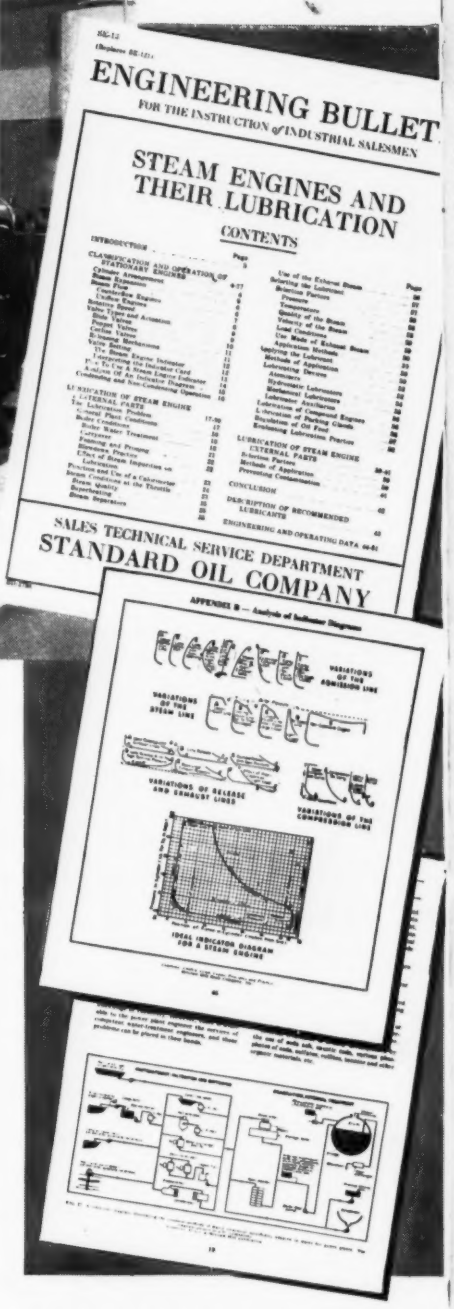
## Use Sandpaper Belt

BRUSHES CAN BE GROUND either by putting a sandpaper belt around the commutator and rotating the armature at slow speed, or by pulling a strip under one or several brushes on an individual brush arm.

Another method uses a brush fitting stone, which is held against the commutator in front of the brush. Abrasive from the stone gets under the brush and cuts it down to commutator's exact contour.

Soft brushes respond nicely when fitting with No 1 sandpaper without using a finer finishing grade. Finish off hard brushes with 2/0 sandpaper. Grinding the face of the brush on a fine






# To help steam engines do a wartime job

• RECOGNIZING the huge overload that many steam engines are carrying in this critical period and the absolute necessity of keeping those engines operating most satisfactorily, Standard Oil now offers this up-to-the-minute Engineering Bulletin on "Steam Engines and Their Lubrication."

This bulletin was written by engineers as a manual of information for our own industrial service representatives. It is made available now to power plant men because of the helpful information it contains for men new on the job and because of the increased importance of steam engine lubrication to all operators.

If your plant is located in the states listed, you can get copies of this bulletin by asking your Standard Oil Man or writing Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 5, Illinois. In Nebraska, write any Standard Oil Company of Nebraska office.

COLORADO • ILLINOIS • INDIANA • MISSOURI
KANSAS • MICHIGAN • MINNESOTA • IOWA
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SOUTH DAKOTA • WISCONSIN

**If you have** a specific problem in steam engine lubrication, ask to have a Standard Lubrication Engineer call at your plant. His suggestions may help you save vital parts or stave off unnecessary shutdowns. His service will cost you nothing.

**Send for this bulletin.** "Steam Engines and Their Lubrication" discusses such subjects as steam conditions and their relation to lubrication, analysis of indicator diagrams, and methods of oil atomization. It may help to clear up specific troubles you are now having.

*Oil is Ammunition . . . Use it Wisely*

**STANDARD OIL COMPANY (INDIANA)** STANDARD SERVICE

★ LUBRICATION ENGINEERING

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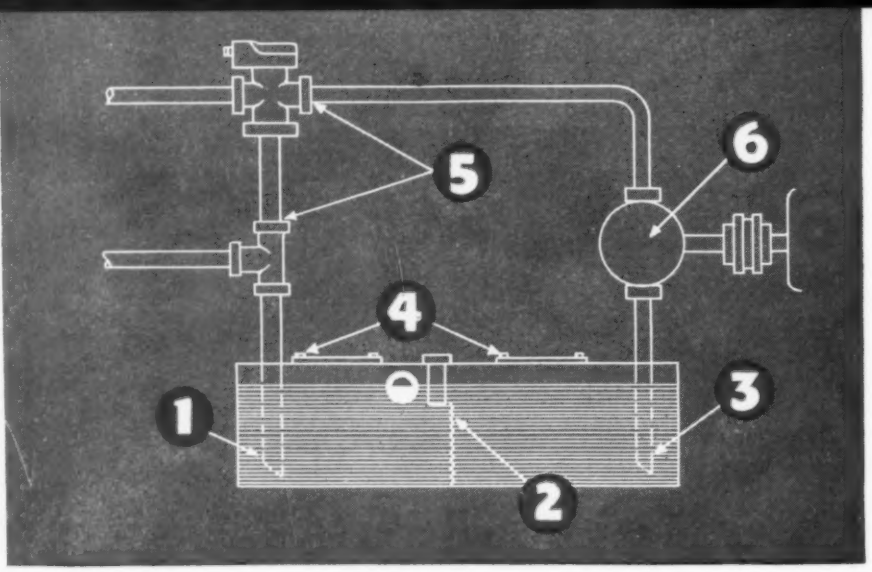



# Hydraulic Oils and how to select them

**Troubles in hydraulic system operation are not always caused by the oil used, but many of them can be avoided by using the right oil. Here are some suggestions for selecting the right hydraulic oil:**

## WHAT TO AVOID

**Viscosity too high.** Most easily detected when starting the unit, by sluggish operation and delayed circulation, which may damage the pump. When operating, too high a viscosity may cause over-heating and rapid oil oxidation. **Viscosity too low.** Indicated by low pressure, erratic operation. It frequently causes leakage at packings and glands. Excessive wear may develop because lubrication is inadequate.

**Poor stability.** Conditions under which hydraulic oils operate (heat—pressure—aeration) tend to cause the oil to oxidize and form deposits in the system. These deposits cause wear on pumps and valves, and erratic operation, which can only be corrected by an expensive cleaning operation. Deposits caused by oil oxidation should not be confused with those caused by contaminants entering the hydraulic system.

**Poor demulsibility.** Although normal precautions are taken to keep moisture and coolants from entering the hydraulic system, some oils will emulsify in the presence of even a small amount of moisture. The resultant frothy mixture is compressible, causing a loss of pressure and poor control of operation.

## WHAT TO LOOK FOR

**High Viscosity Index.** Hydraulic pump and motor manufacturers have definite viscosity recommendations for oil used in their equipment. But for further protection, you need an oil of *high viscosity index*—an oil that resists changes in viscosity with changes in operating temperatures. Stanoil, for example, flows readily at starting, yet maintains suitable viscosity at the required operating temperatures.

**High stability.** There are many reasons why oils oxidize. Briefly, petroleum consists of various hydrocarbons, some of which unite readily with oxygen. This is called oxidation. The problem is to remove these unstable hydrocarbons. This has been accomplished in Stanoils by a unique refining process. Frequent cleaning of oil system, and oil changes necessary because of oil oxidation, are materially reduced with Stanoil.

**Ease of separation from water.** An oil must have good demulsibility—must separate readily from water so it will not form oil and water emulsion. Stanoil has this quality. With reasonable care to keep out dirt, Stanoil will not emulsify and can easily be separated from any water in the system.

These are just a few points to check in choosing a hydraulic oil. Let a Standard Lubrication Engineer help you pick the right grade and type of oil for your specific hydraulic jobs. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you.

## Tips on a typical hydraulic system installation

1. **Oil return line** must discharge below oil level to prevent formation of air bubbles which would cause erratic operation of the pump.

2. **Baffle plate** installed between intake and return discharge helps settle out any dirt in the system and remove air bubbles introduced when filling.

3. **Oil intake pipe** should extend to within two diameters of the bottom of the reservoir, to reduce the possibility of air entering the system if the oil level is low.

4. **Hand holes** are recommended to facilitate inspection of oil and cleaning of oil reservoir, but they must be tightly sealed to prevent entrance of contaminants and water into the system.

5. **Pipe joints** should be made positively leakproof to prevent entrance of water or air and the loss of oil and pressure.

6. **Hydraulic pumps** are accurately machined units. Their continuous, efficient operation depends upon how this accuracy is maintained. The best installation can be a continual source of trouble unless a clean oil of high quality, high stability, and-the right grade, is used.

*Oil Is Ammunition . . . Use It Wisely*

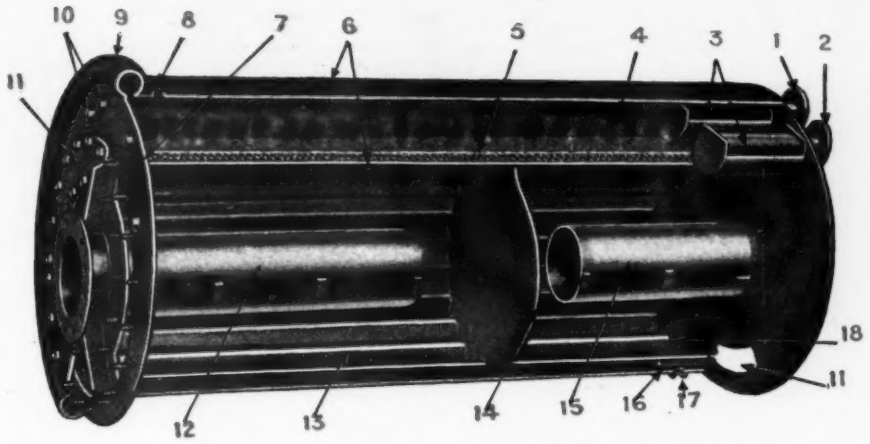
★ STANOIL ★

LUBRICATION ENGINEERING

**STANDARD OIL COMPANY (INDIANA)**

# MAXIM HEAT RECOVERY SILENCERS *save fuel!*

Extra steam or hot water for industrial processing operations or for heating purposes can be readily obtained by utilizing waste exhaust heat with Maxim Heat Recovery Silencers. The fuel saving is obvious, as the heat source is simply the engine exhaust gases which normally are wasted.




1—Steam Outlet
2—Safety Valve Connection
3—Dry Pipes
4—Steam Space
5—Water Line
6—Shells—Cylindrical to withstand steam pressure and pulsating gas flow
7—Inlet Head
8—Pressure Gauge Connection
9—Expansion Joint—permits dry operation
10—Water Gauge Connections
11—Cleanouts—provide easy access for cleaning heating surface
12—Inlet Bleeder Tube
13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
14—Insulated Intermediate Head
15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

**HIGH HEAT RECOVERY**... Maxim Heat Recovery Silencers achieve highly efficient heat transfer through high mass gas velocities and the use of extended heating surfaces, a type of construction that is extremely dependable and requires minimum attention.

**HIGH DEGREE OF SILENCING**... These units embody the Maxim principle of silencing and can be had with or without the spark arresting feature. Based on silencing principles pioneered by Maxim and developed through years of practical field experience, they afford highly effective silencing of exhaust with minimum of back pressure.

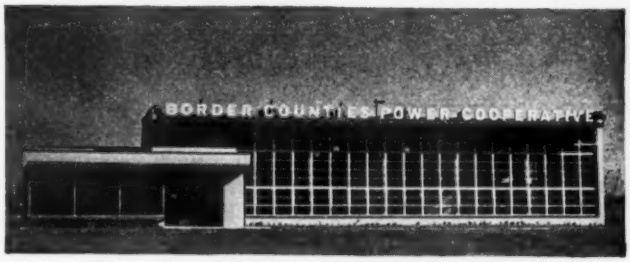
**COMPACTNESS AND LIGHT WEIGHT**... Maxim Heat Recovery Silencers are extremely compact and can in most cases be installed in the space normally used for a regular silencer unit.

**AUTOMATIC CONTROL**... In the boiler, the steaming rate is controlled by varying the amount of water in contact with the heating surface; low water, less effective heating surface; high level, more effective. The control is accomplished automatically by two steam pressure regulated valves, one in the feed line, one in the return line, working in conjunction. (See bulletin WH-100)

**ABILITY TO RUN DRY**... Because of the type of construction, with extended heating surfaces, not tubes, it is possible to run these units dry without any danger of damage.

**QUICK RETURN ON INVESTMENT**... Maxim Heat Recovery Silencers produce usable steam or hot water from a present source of heat. Hence steam or hot water for processing operations or for heating the plant is available with no extra fuel cost. This obvious saving represents a quick and often substantial return on your investment.

**AVAILABILITY**... At this time the Maxim Silencer Company's production is devoted to war needs. It is our feeling, however, that this Waste Heat story has sufficient post-war importance to make your investigation worthwhile now, whether or not your present priority status allows immediate purchase of the equipment.



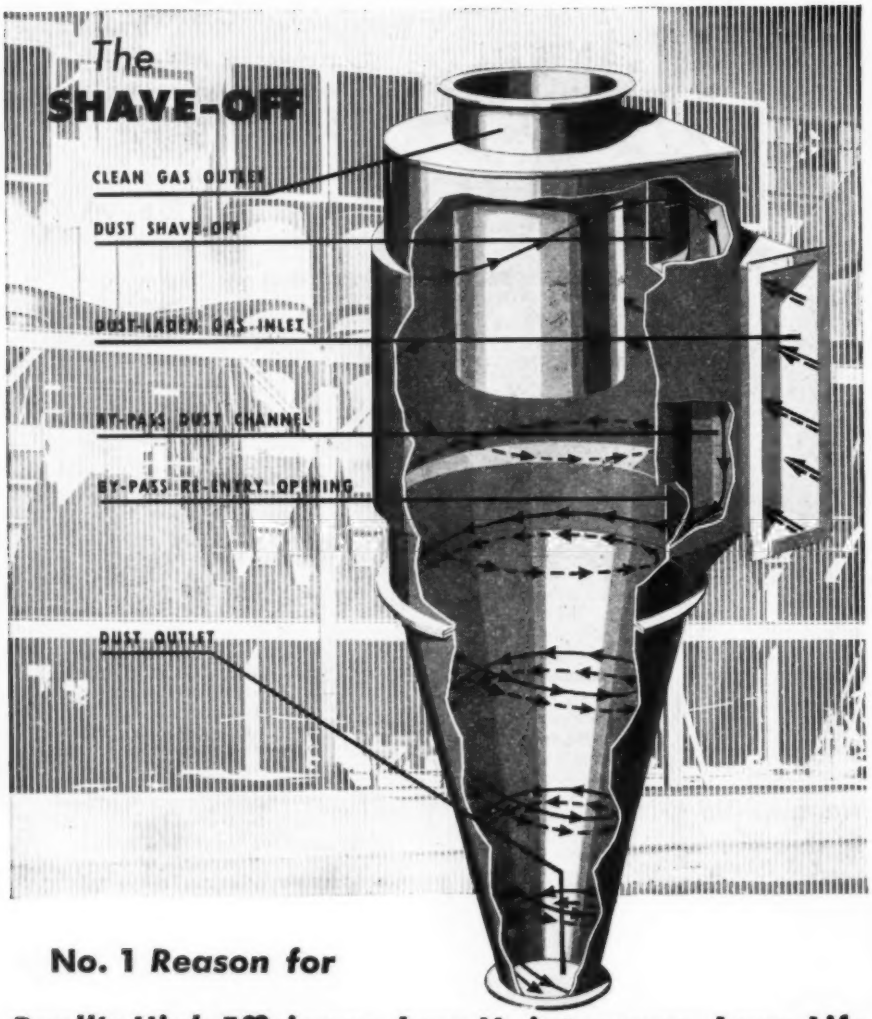

This northern Minnesota power plant is heated entirely through use of Maxim Heat Recovery Silencers.

## SEND FOR DESCRIPTIVE BULLETINS

Maxim Waste Heat Bulletins WH-100, WH-102 and WH-103 will be sent to you on request. Simply send your request to The Maxim Silencer Company at the address below.

**THE MAXIM SILENCER CO.**
92 Homestead Ave., Hartford, Conn.

# MAXIM




**No. 1 *Reason for***

***Buell's High Efficiency, Low Maintenance, Long Life***

Under the principles of dust collection established by van Tongeren, the patented "shave-off," found only in Buell Dust Recovery Systems, increases dust recovery by utilizing the double eddy current (present in all cyclone-type collectors) to establish *a highly efficient collection force.* (See pp. 5-9 in Buell's book: "The van Tongeren System of Industrial Dust Recovery".)

The "shave-off" thus enables Buell to achieve high recovery efficiency without resort to small-diameter cyclones—and Buell's large diameters permit construction of extra-thick steel, efficient operation with low centrifugal force fields, and consequent reduction of abrasive wear. These are major reasons why Buell Dust Recovery Systems in use three, four, five or more years have established outstanding records for trouble-free service and low maintenance cost.

*Any engineer will find convincing substantiation for these claims in Buell's factual, 28-page book mentioned above. You may obtain a copy by writing for Bulletin G-842.*

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| BUELL FEATURES | RESULT IN | PRODUCE |
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| LARGE DIAMETERS | LESS FAN BLADE WEAR | LOW MAINTENANCE |
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| LARGE OUTLETS | LOW POWER CONSUMPTION | LONG LIFE |
| INNER WELDS GROUND SMOOTH | HIGH TEMPERATURE RESISTANCE | NO CLOGGING |
| CORRECTLY DESIGNED HOPPERS | UNLIMITED CAPACITY | |
| SPLIT-DUCT MANIFOLDS | NO MOVING PARTS | |
| | FREE DUST FLOW | |

*DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"*


grinding wheel to an approximate fit saves considerable elbow grease.

Whenever conditions permit, run brushes in at no load 24-hr. Collector ring brushes should be fitted just as carefully as commutator brushes. Reversing the lead polarity periodically on synchronous motors and ac generators prevents spotting the rings if they are cast iron.

*Hamilton, Ont.* J A CAULDEN

## Questions and Answers

(*Continued from page* 122)

other insulating covering, remove enough of this covering to examine plates, riveted joints and points of attachment of fittings to the shell.

*Q 13—What is your duty when you discover any defects in the boiler or boilers under your charge?*

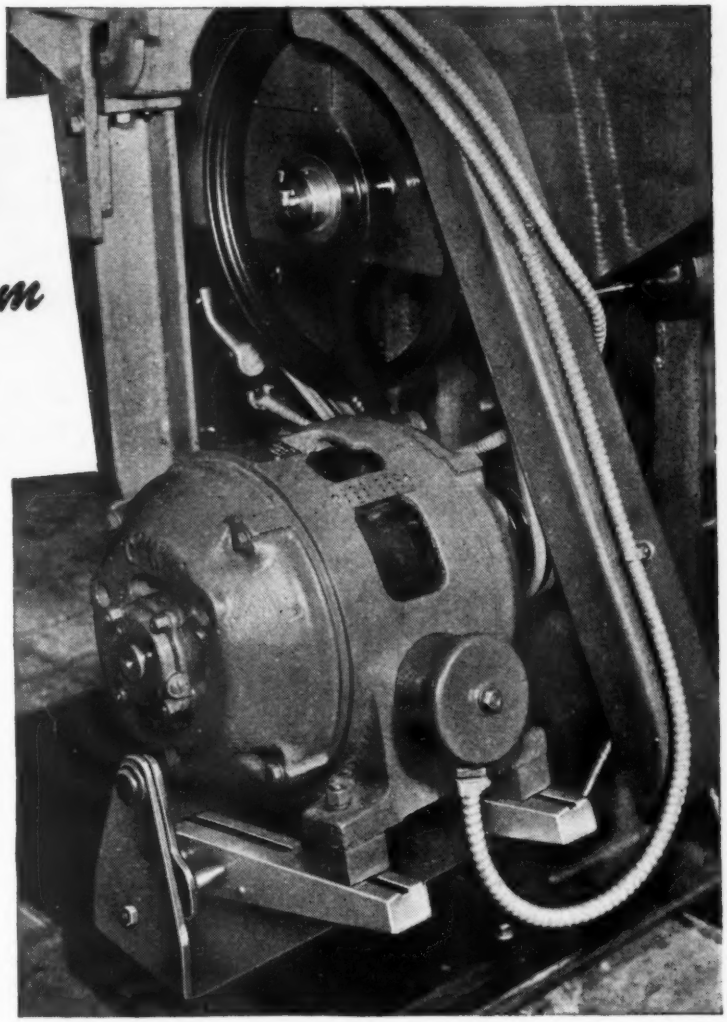
A—The answer to this important question may be governed largely by such local conditions as nature and size of plant, nature of load, plant personnel, system of boiler inspection, regulations regarding inspection of boilers and distance from the boiler inspection headquarters.

If the defect is obviously dangerous the engineer has no alternative. He must shut down the damaged boiler immediately and notify his employer and the boiler inspector. The inspector should then give instructions regarding the repairs or replacements necessary to put the boiler in safe working condition, and he should inspect and approve these changes before the boiler is again put in service.

Where the boiler inspector's services are immediately available, as is usual in thickly populated centers, the engineer should always follow the above procedure, and leave matters to the inspector's judgment, though a shutdown may not actually be necessary unless the inspector orders it.

In sparsely settled communities or isolated plants far from any boiler-inspecting center, the stationary engineer, like the marine engineer, may sometimes have to rely upon his own judgment as to carrying on or making minor repairs before the inspector can be notified and inspection made. This is especially true where a shutdown may result in great inconvenience and perhaps human suffering. Under no circumstances should risks be taken that might result in a boiler explosion. Where it is absolutely necessary, in these isolated cases, to carry out minor repairs, notify some competent boiler-in-

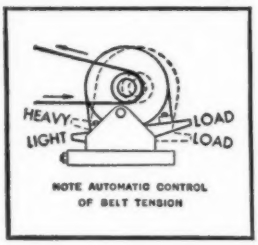
# HOW TO SOLVE THE *Belt Tension Problem* IN YOUR PLANT



SINCE the productive efficiency of any belt-driven machine depends largely on the efficiency and trouble-free operation of the drive, *belt tension* is a problem in every plant.

When belts are not tight enough, they slip. As a result, machine R.P.M. are lost and output reduced. When belts are too tight—wear on belts and bearings is excessive. This results in machine shutdowns due to drive failure, with consequent costly interruptions to production.

American Econ-o-matic Drives solve these belt tension problems. By utilizing the torque reaction of the motor, belt tension is *automatically* matched to the load. On a heavy load, belt tension is increased. On a light load it is reduced. No slide rails, no idlers to adjust—*it's automatic!* Belt slip is eliminated. Belt and bearing life is increased. Maintenance man-hours reduced by as much as 75%. And machine output increased as much as 15%.

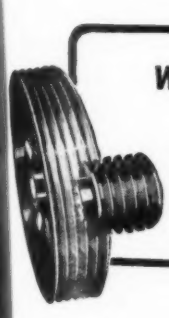



There is only one way to get *automatic* belt tension control—specify American Econ-o-matic Drives. Write today for your copy of the Econ-o-matic Handbook. It gives you complete drive tables, specifications and installation instructions.

### *Textile Mill Cuts Equipment Cost in Half Through Tension Control*

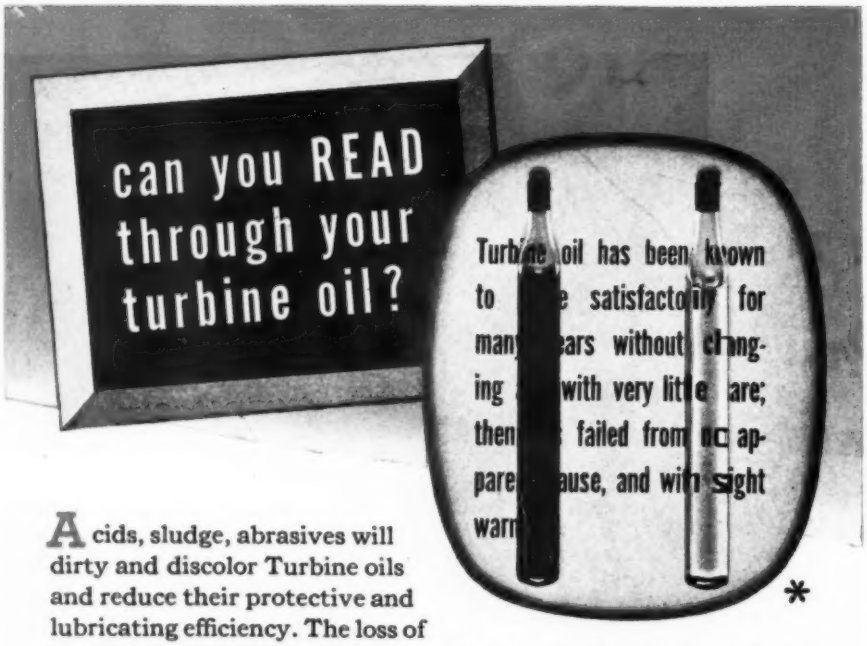
High starting loads are tough on knitting machines. So when this textile company wanted uniform production and constant speeds, they equipped their machines with American Econ-o-matic Drives. As a result, substantial savings in operation have been effected. Maintenance has been held at minimum. And they obtained a 50% reduction in the cost of electrical equipment. All through the Econ-o-matic Drive's automatic belt tension control.

*The American Pulley Company*
4224 WISSAHICKON AVE., PHILADELPHIA, PA.



### *WEDGBELT SHEAVES*

American Wedgbelt Sheaves are made to the highest precision standards. They are made of sound, strong metal, accurately machined, finely finished and carefully balanced.

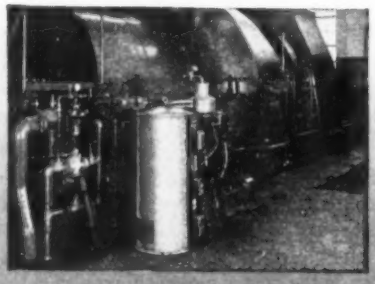



Acids, sludge, abrasives will dirty and discolor Turbine oils and reduce their protective and lubricating efficiency. The loss of this lubricating efficiency will result in excessive wear and serious damage to bearings or other moving parts.

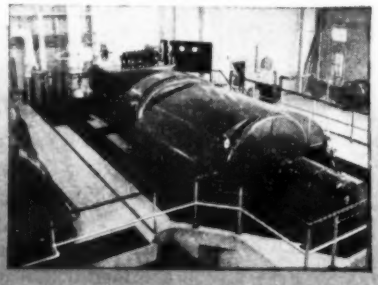
There is, therefore, a definite need for a regular program of thorough and complete oil purification that will remove all dangerous contamination and maintain clean, color clear lube oil.

Honan-Crane "Continuous" Oil Purifiers will keep Turbine oil completely safe and color clear:

- *By removing the most minute abrasives*
- *By preventing sludge formations*
- *By safely adsorbing acids*
- *By safely controlling steam emulsion*



Standard Units are available to handle the largest Turbines. Above is Honan-Crane Purifier purifying the oil for a 30,000 K. W. Turbine. Units are completely insulated and automatic.



Streamlined, advanced in engineering and design, these units are welcome in any plant. Above are two Honan-Crane Purifiers purifying the oil for a 5000 and a 7500 K. W. Turbine.

★ Unretouched photographs shows two bottles of the same Turbine oil. At left as taken from the operating Turbine. At right after purification through a Honan-Crane Purifier.

For complete information on the purification of Turbine oils, write . . .

**Honan-Crane Corporation**
1200 SIXTH AVENUE, LEBANON, INDIANA


spection authority at the earliest possible moment.

*Q 14—What is corrosion? How is it caused and prevented?*

A—Corrosion is an eating away of the surface of plates, tubes and rivets or stays by acid impurities in the boiler feedwater. Prevent it by changing over to a purer feedwater. If this is impossible, treat the feedwater so as to neutralize the contained acids. Air dissolved in the feedwater is also a cause of corrosion and a special apparatus called a *deaerator* is sometimes used to remove oxygen and other dissolved gas from the water before it enters the boiler. Some types of open feedwater heaters are also efficient deaerators, particularly those called deaerating heaters.

Zinc slabs, securely fastened to some part of the inner boiler surface, are sometimes used to reduce corrosion. The zinc is attacked and eaten away by the galvanic action of the corrosive agents instead of the boiler metal. When zinc plates are used, suspend metal trays beneath them to catch falling debris or it may pile up on some part of the boiler heating surface, causing this surface to become overheated and burned.

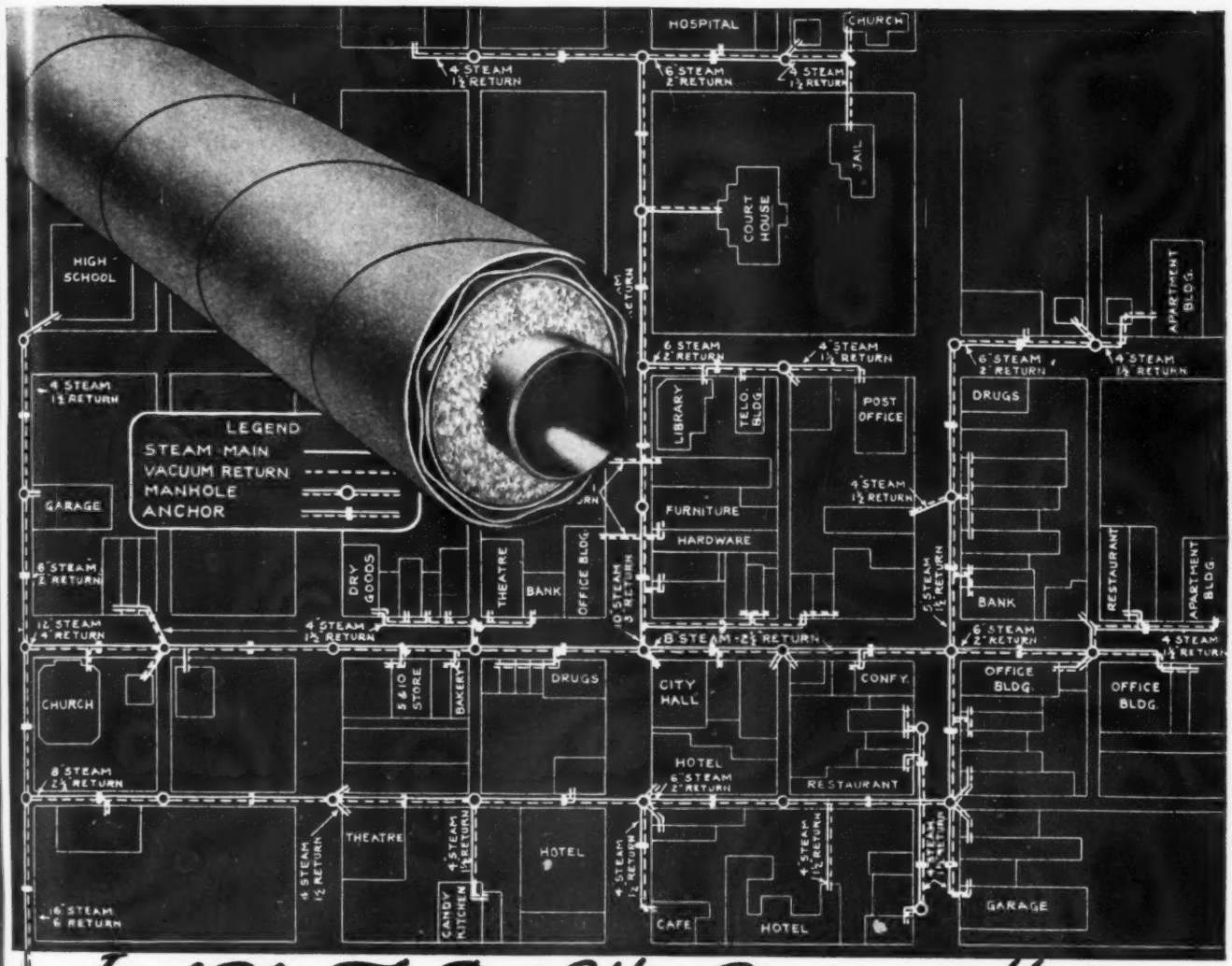
*Q 15—What is pitting?*

A—This term is applied to corrosion that is not uniform over the entire metal surface, but occurs only in small spots or pits and gives the metal a honeycombed appearance. Pitting is caused by lack of uniformity in the metal. It may be that the parts which are eaten away contain impurities or material more susceptible to corrosion than the rest of the metal. Or again the differences may set up local galvanic couples, as when copper and zinc are in contact in an acid solution.

*Q 16—What is caustic embrittlement?*

A—It is actual physical change in metal that causes it to become extremely brittle and filled with minute cracks, especially in the seams of riveted joints and around the rivet holes. Although hundreds of thousands of dollars have been spent in research, the exact causes of embrittlement are not fully understood. It is believed to be caused by the action of caustic soda in boiler water, either naturally present in the feedwater, or introduced in excessive quantities by some form of chemical treatment. To prevent caustic embrittlement, feedwater causticity should be kept below the danger point by suitable chemical treatment and all riveted joints calked on the inside.

(*Continued on page* 162)




# *Ideal Plan For Post-War Community Heating*

## A CENTRAL HEATING PLANT + RIC-WIL CONDUIT

Outstanding among the advantages of community planning are the benefits gained from central heating—making it possible to purchase *heat* as a commodity like gas, electricity or city water. Ric-wiL Prefabricated Insulated Pipe Conduit provides the most easily installed, dependable, economical and efficient system of heat distribution—proven by more than a thousand miles of all types now in service.

### ADVANTAGES OF CENTRAL HEATING WITH RIC-WIL PREFABRICATED CONDUIT

#### *CONSTRUCTION ADVANTAGES:*

- Conduit furnished complete with prefabricated field accessories.
- Prefabrication minimizes field work.
- Conduit is accommodated in narrow, shallow trench.
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- Little or no interference with other construction.
- 21-ft. lengths for speedy installation.
- All-weld construction provides durable, watertight system.
- System is efficient, dependable, maintenance-free.

#### *SERVICE ADVANTAGES:*

- Savings of 15% or better in overall fuel consumption.
- Elimination of furnace or boiler tending by consumer.
- Promotes cleanliness in buildings heated.
- Provides extra room in building basements.
- Decreases fire and explosion hazard.
- Reduces smoke and soot, provides cleaner, healthier community.
- Eliminates private coal delivery and ash removal.
- Gives uniform, clean heat quickly, whenever needed.

*Write for detailed information on Ric-wiL Conduit for central heat distribution.*

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THE RIC-WIL COMPANY · CLEVELAND, OHIO
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YOU NOW CAN GET

SANTOSITE

WITHOUT A PRIORITY!

**Addition Of Santosite To Boiler Feed Water Is Low-Cost, Positive Protection Against Oxygen Corrosion**

SANTOSITE is off the priority list! There now is a plentiful supply of this economical chemical that is a positive treatment for the removal of dissolved oxygen from boiler feed water, thereby protecting steam-generating plants against oxygen corrosion. We are confident that there will be ample Santosite from now on.

Power plant operators, who have years of experience in the use of Santosite, find that 30 parts of the chemical to a million parts of water is sufficient to eliminate the danger of oxygen corrosion. Santosite is an anhydrous crystalline product that is easy to handle, store and apply.

Why not get complete details on the benefits to be gained from the use of Santosite? Your request for information will get prompt attention. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal, Toronto.

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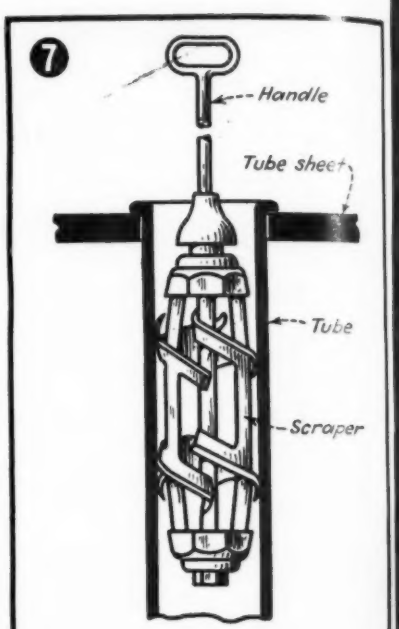
"E" FOR EXCELLENCE—The Army-Navy "E" burgee with two stars, "representing recognition by the Army and the Navy of especially meritorious production of war materials" over a two-year period, flies over Monsanto's executive offices in St. Louis and over Monsanto plants at Anniston, Ala., and Monsanto, Tenn. The Army-Navy Production Award also has been won by five Monsanto plants at St. Louis, Mo., Monsanto, Ill., Karnack, Texas, and Springfield, Mass.



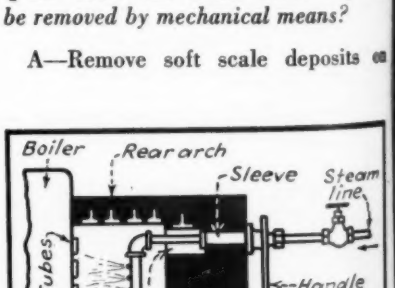

*Q 17—How is soot removed from the inside of firetubes?*

A—Soot deposits are usually removed by hand scrapers made to fit closely in the tube or by steam blowers operated by hand or built into the boiler setting. A hand scraper for removing soot is shown in Fig. 7, and a permanently installed soot-blowing attachment for a hrt boiler in Fig. 8, where the short vertical pipe carrying the blowing jets can be rotated through a semicircle by the outside handle. When the blower is not in use, the short horizontal pipe is slid back through the steamtight sleeve and the blower pipe placed horizontally in the brickwork recess, away from the direct sweep of flames and hot gas.

Blowers for watertube boilers usually consist of horizontal pipes carrying a number of small steam jets set to blow downward vertically or diagonally between the tubes. The blower pipes are supported on top of the tubes and can be rotated from the outside of the setting.

*Q 18—How can boiler scale deposits be removed by mechanical means?*

A—Remove soft scale deposits on



# DOING A WARTIME JOB...

## PROTECTING INDUSTRY AGAINST WASTE

## *PACKINGS FOR EVERY PURPOSE*

Anchor Packing Company is proud of the privilege of serving the many industries who are directly or indirectly manufacturing essential and vital materials for the Armed Forces of our own Country and our fighting Allies. We have established a service record of which we are justly proud and are continually using our best endeavors to improve our products to meet new problems as they arise. When peace is restored and we all return to normal conditions, the experience we have gained through our own research and from actual service will enable us to aid our customers to a greater extent than ever before.

**THE ANCHOR PACKING COMPANY**

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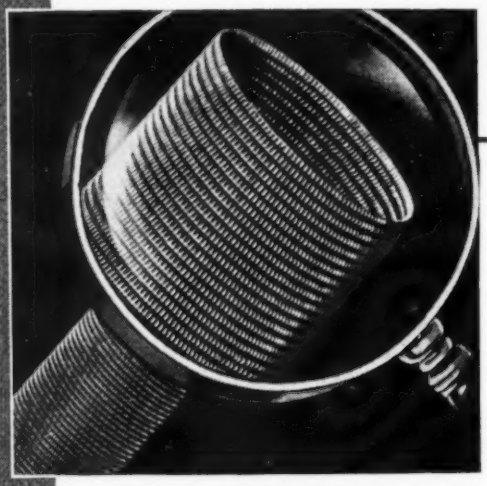
Rust · Scale · Dirt

FROM CLOGGING
STEAM EQUIPMENT



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- *Body Cadmium Plated Inside and Out for Protection Against Corrosion.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Over 100 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 Lbs.*

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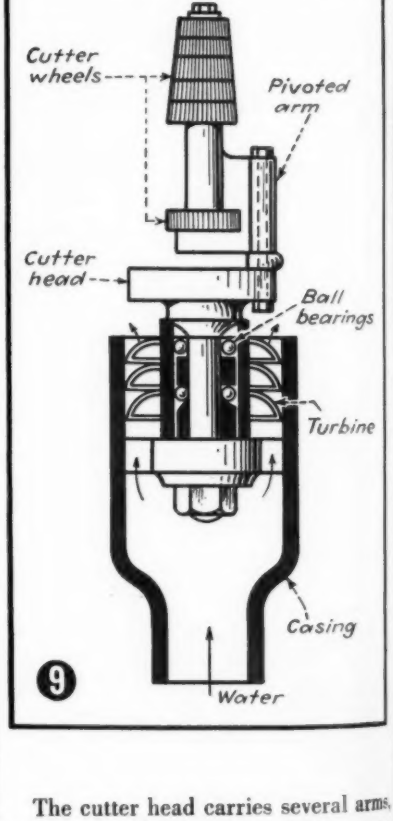
YARNALL-WARING COMPANY
100 MERMAID AVENUE PHILADELPHIA 18, PA.

YARWAY STRAINERS

plates and tubes by hand scrapers, special long-handled tools being used to reach parts not readily accessible. If the scale is hard it must be chipped off with chisels and hand hammers, or with air hammers if compressed air is available. Remove hard scale deposits on fire tubes by an air- or steam-driven vibratory hammer. Watertubes are usually cleaned by turbine-driven wheel cutters.

*Q 19—Sketch and describe a mechanical watertube cleaner.*

A—Fig. 9 shows a common form of watertube cleaner, a water-turbine-driven rotating cutter. Water, supplied through a flexible hose, passes through guide channels in the casing which direct it into the turbine wheel, making it revolve and turn the head carrying the cutters. After driving the turbine wheel, the water passes out through the front of the casing and washes away the scale loosened by the cutter-wheel action.




The cutter head carries several arms, to each of which cutter wheels are attached. To avoid confusion only one arm and set of cutter wheels is shown in Fig. 9, but all the arms are attached in the same way, and spaced equal distances apart in the cutter head. These arms are pivoted on the attaching pins to fly outward by centrifugal force as the cutter head revolves. The cutter wheels then press against, and cut away, any scale

*Quick relief from...*

# "equipment shortage" grief

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**RESULT:** *1050 Kv-a of Transformer Capacity released for immediate and future loads; new wiring and transformer unnecessary.*

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Inerteen Capacitors measurably improve motor performance, lighting conditions, and all around system performance. Send for our new book on Inerteen Capacitors, B-3204. Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., Dept. 7-N.

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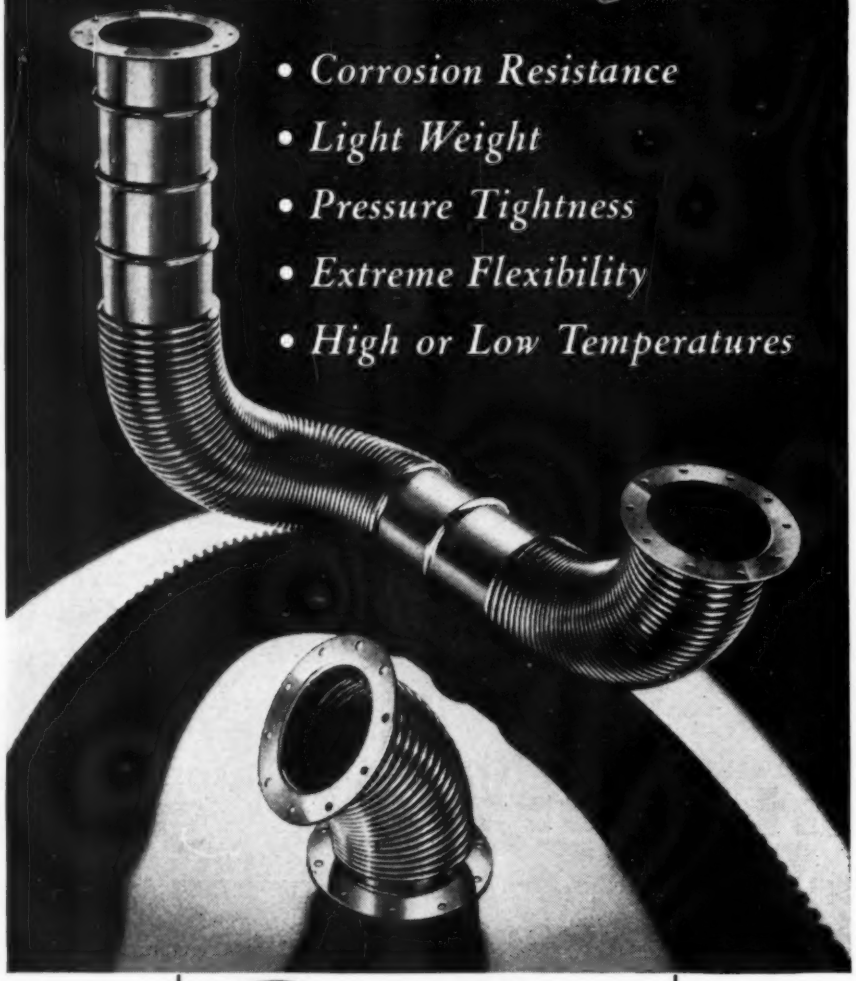

- *Corrosion Resistance*
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## Rex-Flex Stainless Steel Flexible Tubing

**C. M. H. STAINLESS STEEL BELLOWS**
Available for all industrial applications.

For industrial maintenance applications involving extreme corrosive conditions, chemical conveying problems, high temperatures, great flexibility and accelerated flexing fatigue, Rex-Flex Stainless Steel is the ideal flexible tubing for the job. This tubing is light, strong, gastight and manually bendable in multiple planes. It is available in long lengths, in 5 wall forms, unbraided or braided for high pressure uses. Sizes range from 3/8" to 5" I. D. inclusive. Fittings are resistance seam welded to form uni-metal assemblies.

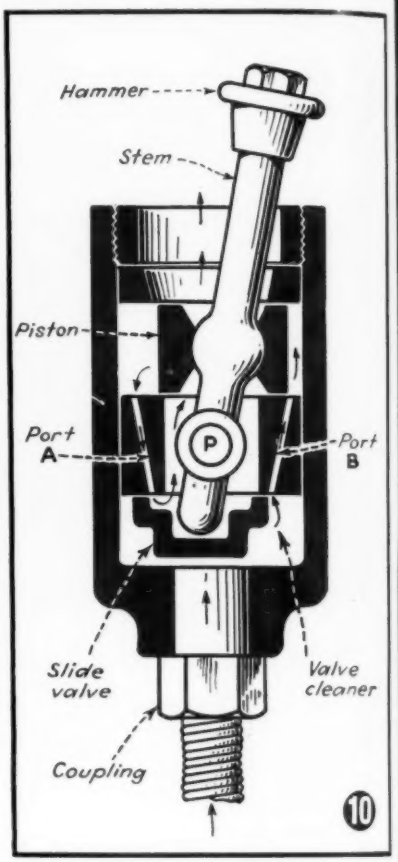
If you have a problem involving flexibility, vibration or kindred service, we have a flexible metal hose that will solve that problem. Write for our engineering recommendations.

**Chicago Metal Hose Corp.**
**Maywood, Illinois**


adhering inside the tube. Cutter wheels are hardened tool steel.

*Q 20—Sketch and describe operation of a steam or compressed-air-driven vibratory hammer for removing scale from firetubes.*

A—Fig. 10 shows a sectional view of such a hammer. Compressed air or steam enters the valve chamber through




a flexible hose and is alternately admitted to ports *A* and *B* by the slide valve, which in turn is operated by the short end of the hammer stem, which passes through the piston, being pivoted at *P*. As the piston reciprocates it carries the hammer with it. Hammer blows are light, but extremely rapid (3000 to 4000 a min). Vibration thus set up loosens scale on outside of tube and also any hard layers of soot on the inside.

As high-pressure air or steam is admitted to one side of the piston, air or steam that has already done work on the other side of the piston is exhausted back through the port to the central recess in the slide valve and out through the casing front. This exhaust blows out any hard soot that the vibration may have loosened. Compressed air is more suitable than steam if the boiler is cold, as water condensing from steam is apt to make soot gummy and hard to remove.

# How Radium Helps Make Ⓢ Worth Looking For...

HERE, Sivyer metallurgists and foundrymen study a radiograph of a casting—a photograph of the insides of the casting made with gamma rays emanating from a capsule of radium. From such a picture, Sivyer can find out how sound the casting is and—if need be—can alter the molding and pouring methods for handling the job. This is but one of the ways in which Sivyer utilizes science to help make castings that are good enough to carry the Sivyer trademark—the Ⓢ that so many buyers have learned is worth looking for.

SIVYER STEEL CASTINGS

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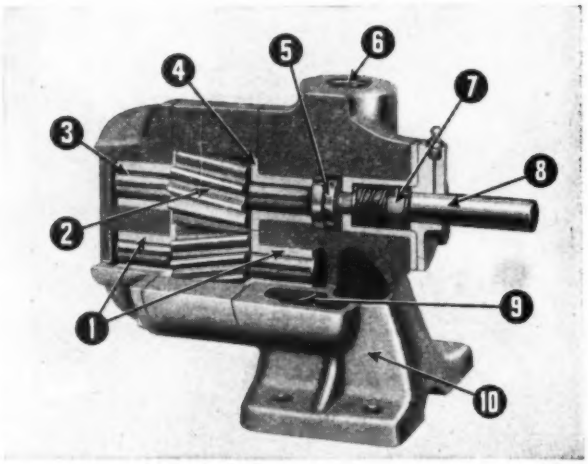
ARMY E NAVY

# NOTE THESE FACTS BEFORE YOU BUY ANOTHER PUMP




## Ten Reasons for Choosing ROPER

1. LARGE BRONZE BEARINGS — two on each side.
2. SPIRAL PUMPING GEARS — Perfectly machined and run-in.
3. CONSTANT LUBRICATION — (1) by liquid being pumped and (2) by lubricating qualities of the bearing metal used.
4. WEAR PLATES protect face and back plates from wear by foreign matter.
5. THRUST COLLAR on drive shaft plus sliding joint takes up shock and thrust.
6. FOUR PIPE OPENINGS provide eight different piping arrangements.
7. MECHANICAL SEAL reduces power requirements and keeps leakage to minimum.
8. SPLINED DRIVE SHAFT forms sliding joint with gear to absorb shock and thrust.
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10. ONE PIECE BACKPLATE protects working parts from stress and strain.

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Equal size pumping gears operating at the same speed. Roper Hydraulically Balanced Pumps, quiet and smooth in operation, last longer with less servicing because of their simplicity and because internal pressure is equalized at all points.

## ENGINEERING SERVICE

Roper Sales and Engineering Service reaches from coast to coast. All representatives have a thorough knowledge of engineering and a wealth of practical experience. Their services are promptly available to help you solve your pumping problems.

*Write for Catalog*
**No. 144**

With many illustrations, cut-away views, drawings, dimension and pumping capacity tables and complete information on Roper Pumps.

**GEO. D. ROPER CORP., ROCKFORD, ILL.**

**ROPER *Rotary* PUMPS**


## Large Boiler Goes Places

(*Continued from page* 102)

changes air flow slightly. If this adjustment causes a change in color of the stack gases, the electric eye instantly adjusts air volume until stack-gas color returns to normal. Each control unit has a remote hand-control switch with red and green indicating lights on the panelboard. This switch permits the operator to hand-set any unit.

### *Dust Collector*

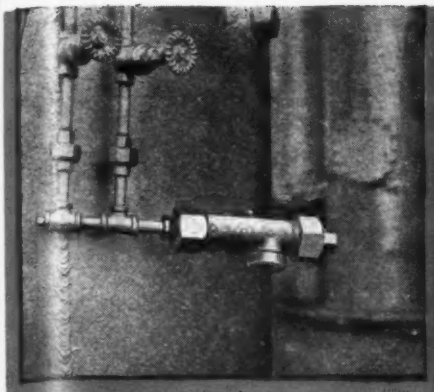
Products of Wyomissing Industries require minimum contamination of air surrounding the buildings. Therefore, gas from the boiler passes through a centrifugal dust collector consisting of a series of horizontal tubes with spiral fins on their outer periphery. Dust from the collector goes to a cyclone that discharges directly into a storage tank. From the storage tank the dust goes to a mixer which adds enough water to form a heavy dough that is discharged to a motor truck underneath. At present, the mixer is located under the boiler operating floor. When the plant is completed, dry dust will discharge into an outdoor storage tank with the mixer under it for adding water to the dust.

### *Coal Handling*

Coal, delivered in cars to an existing trestle about 100 ft long in front of the boiler house and 14 ft above the main floor level is stored in pockets under the trestle's full length. We installed a new coal elevator at one of these pockets opposite the center of the new boiler. In an underground tunnel running the length of the trestle, a screw conveyor and control gates permit coal delivery from any storage pocket to the elevator. The elevator also receives coal direct from the pocket opposite it and discharges by gravity to the overhead bunker; from there coal goes by gravity to the two pulverizers through automatic batch-weighing scales.

### *Feedwater Treatment*

Zeolite-softened water available for feedwater makeup required a reduction in alkalinity content to avoid excessive blowdown. Makeup water goes through a rate-of-flow controller and to the head box above a forced-draft aerator where sulphuric acid is added to reduce its alkalinity. In this treatment carbon dioxide forms in the water in excessive amounts, but the air removes it when the water passes through the aerator on



OUTDOOR TANK

PLATING

# *The Steam Trap with a Brain*

**CONTROLS TEMPERATURE WHILE REMOVING CONDENSATE**

Here's one for your book! A steam trap that opens only when the tank or kettle is at the temperature which you select. Only a company making *both* steam traps and control could have thought of it. You can see that it has the elongated Sarco bellows like a temperature regulator, but otherwise is as simple and inexpensive as a steam trap.

That's why thousands of these special trap controls are used for process steam heated equipment and tanks heated by steam coils. Because it cannot freeze, it is also used for long steam lines outdoors, and even for radiators, coils, and heater lines in the refinery, coal, and other outdoor industries.

Several forms of this trap are available. Please tell us exactly what you want to accomplish. Hook-ups are shown in Catalogs Nos. 250 and 550.

**SARCO COMPANY, INC.**
**475 FIFTH AVENUE**
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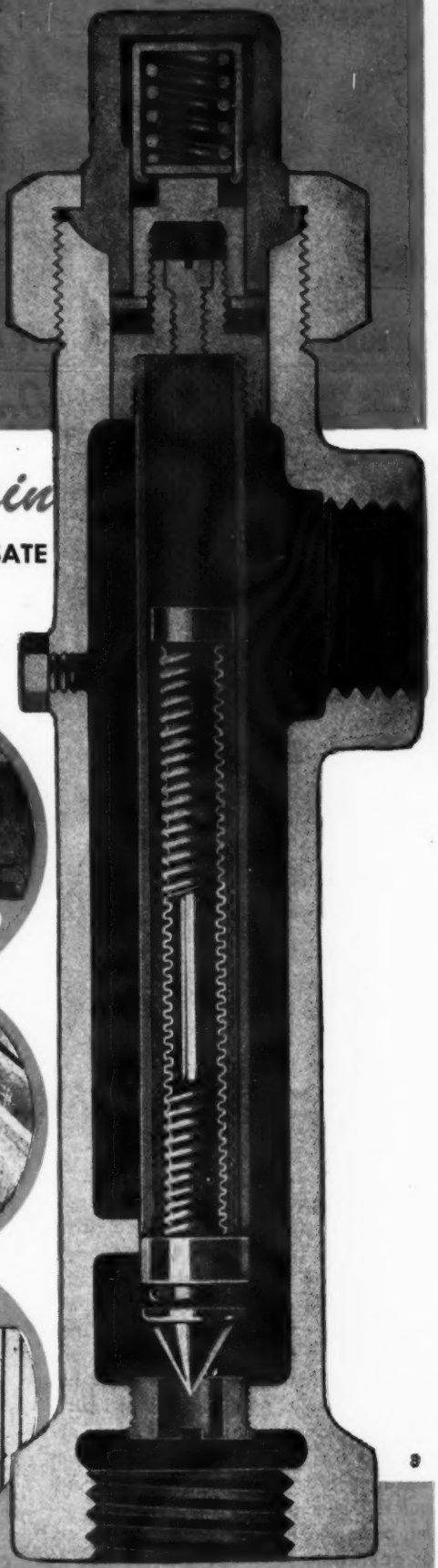
**SARCO 87**



**SARCO Saves Steam**

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO *Represented in Principal Cities*

Write for Working Sample
Send for 36 page catalog.

**Put "AMBEST" to a long life test on any tough job**

"EUREKA"

This UNIVERSAL packing — of long, pliable, anti-friction metallic alloy strands—assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F. — is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

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*Powerful-Fast*

# ROTO Junior Tube Cleaners for small tubes

For cleaning light scale from very small tubes, the fully self-contained Roto Junior Tube Cleaner offers advantages possessed by no other type. It is built with watch-like precision on the same time-tested principles as our large cleaners. The unusual power for its size is due to the positive contact between the solid blade and Rotocentric bore cylinder, which provides an undivided air stream and freedom from leakage. Roto heads and brushes have quickly-replaceable, inexpensive wearing parts which reduce greatly the cost of operation.

**Simple Construction**

A shaft and solid blade are the only moving parts in the Roto motor.

**The ROTO Company**

145 Sussex Ave. Newark 1, N. J.


its way to the feedwater storage tank.

A float switch in the storage tank stops and starts the rate-of-flow controlled to maintain the correct level in this tank. This float switch also controls the acid-feeding pump. In the boiler-feed line an orifice meter controls a proportioning pump that feeds chemicals into the boiler in proportion to rate of feedwater flow, to remove residual oxygen and also residual hardness so that it will not form scale.

The old feed pumps and feedwater heater have sufficient capacity to take care of the new boiler until it goes on high pressure and temperature.

### *Operation*

We fired the new boiler for the first time in November, 1940. After we had tuned it up and instructed the operators for six weeks, the boiler carried the winter load continuously without a shutdown or any operation of the stoker-fired boilers. The plant operators made the transition from stoker operation of the old boilers to pulverized-coal firing of the new boiler easily.

Maintenance costs have been low. Repairs to the pulverizer run about 2.56¢ per ton of coal pulverized. Boiler tubes were turbined once as a precaution but no scale was found and no tubes have been replaced. Furnace maintenance consists of routine cleaning during the annual inspection. So far, soot blowers have not needed any repairs. Front boiler tubes are cleaned by retracting blowers operated from each side wall of the furnace; therefore, the blowing elements are not exposed to hot gas. Elements exposed to gas operate in a temperature around 1100 F maximum. This arrangement promises low maintenance costs throughout the unit's life.

The air heater does not have soot blowers but is cleaned by a turbine

### There's a POWER Shortage

**Libraries in war areas are going to need help. Requests already received by the American Library Assn. indicate that through financial inability to renew, loss of shipments and destruction of libraries, an enormous number of technical magazine sets will be broken.**

**You could not make better use of your copies of POWER than to pass them on to engineers in war-torn countries. Address questions to Dorothy J. Comins, Executive Assistant, Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D. C.**

IN YOUR POST-WAR PLANNING

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for complete PIPING PRE-FABRICATION and INSTALLATION

Whatever your piping requirements, Shaw is equipped to handle your installation efficiently and quickly. No matter how small or how large the job — whether for high or low pressure piping. We can offer you the engineering knowledge gained through our fifty years of specialization in the pre-fabrication and installation of every type of piping. And, we can meet your time schedules for we maintain a field force equipped and trained to do on-the-spot prefabrication and installation. When it's piping — call on Shaw.

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Construction Manager

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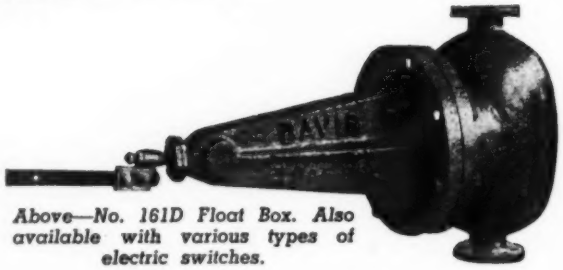
# If It's Liquid Level Control, DAVIS Has It—



*Above—No. 161D Float Box. Also available with various types of electric switches.*

*Above—No. 60 Float Valve. No hunting or water hammer.*

**If you have a problem involving liquid level control, remember that Davis engineers have a wealth of experience available to help you, and a broad line of equipment for practically any service condition.**

**Davis makes many time-proved types and sizes of float boxes, float and lever tank units, float and lever operated valves, and combinations of these units for every conceivable application — direct or remote control of valves, pumps, switches, signals, indicators, etc. Literature on request.**

**OTHER AUTOMATIC VALVE SPECIALTIES**

Liquid level controls represent but one of the complete line of Davis automatic valve specialties to meet your requirements for pressure or flow control of steam, air, gases or liquids. Technical bulletins are available.

*Float and lever unit with Dia-Ball packless unit.*

*Right — No. 61 Fluid Control Valve. Tight closing. Easy opening against pressure.*

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**2540 Washtenaw Ave. Chicago, Illinois**

DAVIS VALVES **DAVIS REGULATOR COMPANY**


cleaner with wire brush once a year at a cost of $30.

Repairs have not been made on the forced- or induced-draft fans or their drives. The dust collector removes a large part of the ash from the flue gas so that wear on the fan blades is small. Furthermore, the wide range of fan speed provided by the magnetic drive on the induced-draft fan makes it possible to operate always at a speed not higher than that required by the load, and helps to reduce wear on the fan. Dust collector parts, including the small circulating fan, show no wear.

Boiler and furnace were designed for maximum continuous operation of 100,000 lb per hr. During cold winter days, steam load has reached 125,000 lb per hr, which the unit easily carried. An over-all boiler and furnace efficiency of 85.1% was anticipated at maximum load. Records of coal burned and steam produced over a trial period of 18 days from Dec 26, 1941 to Jan 12, 1942 showed over 86% over-all boiler and furnace efficiency. During this time, maximum steam load reached 114,000 lb per hr and minimum 10,000 lb. This high efficiency, sustained over such a wide load range, justifies the installation of one unit large enough to carry the maximum load and flexible enough to carry low loads.

Wartime difficulties in obtaining fuel oil and the scarcity of anthracite fines have justified selecting bituminous-coal firing. In addition, bituminous coal probably will continue to be the most stable fuel supply.

## Barley Anthracite Mixtures

(*Continued from page 69*)

to coat the anthracite particles so they are entrained in the subsequent coke structure. Thus the larger the percentage of bituminous fines the less important thoroughness of mix becomes and larger percentages of anthracite can be used. On the other hand, the higher the percentage of anthracite goes the more thorough must be the mixing, otherwise bituminous particles do not coat the anthracite. With a fairly good coking bituminous of nut-and-slack size, amounts up to 66% anthracite are not critical as to mixing. Thoroughness of mixing becomes less important in multiple-retort underfeed stokers than in single-retort units because the several rams produce some additional mixing.

The more times coal is handled between bin and fire bed the better the resulting mixture. For example, in most

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Have you checked the cost of operating your boiler plant *recently*? Are you sure that it is producing each pound of steam at the lowest possible cost?

Post war must mean competition, when your industrial life will depend on your plant's ability to manufacture the best product at the lowest cost. Remember that *steam* is one of your important raw materials. Make that check of your steam costs right away and compile specifications for any improvements which may be indicated. Plants which neglect this precaution may drop behind in the race.

Hundreds of industrial plants and commercial buildings are already benefiting from low cost steam production with TODD combustion equipment. *Are you?* Plant managers who investigate and plan their requirements now will be ready to take advantage of the first opportunity to secure TODD liquid or gaseous fuel burners.

So, prepare today for a competitive tomorrow! TODD will be glad to aid you with an impartial survey of your boiler plant.

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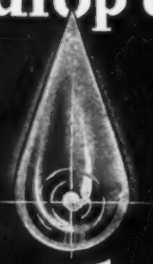
**ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT**

# Just a drop of water-



# harmless···

## *or is it?*

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

**WATER CONDITIONING SYSTEM**

TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

For your own satisfaction, investigate the new TECHNICAL System . . . Nature's own conditioning method developed under actual industrial operating conditions. Without obligation the coupon below will bring you the facts.

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stoker installations, coal goes to a belt conveyor, elevator, or bucket and monorail. It then moves into the stoker hopper and is conveyed by pusher or worm to the bottom of the retort and then upward to the fire, thus providing several mixings. On the other hand, in small plants the fireman often shovels coal direct from bin to fire, which means that mixing must be done before delivery to the bin and that it must be adequate because no further mixing will result.

How can mixing be done? This depends on how coal is received (barge, rail or truck) how it is stored (indoors or outdoors) how it is loaded and reclaimed (clamshell, bulldozer, drag scraper, etc) and how it is delivered to the fuel bed. Mixing should begin at or even before receipt of coal. For example, on truck deliveries *layer-cake* mixing does a good job. At the dealer's or plant-storage yard, the desired proportion of barley goes into the bottom of the truck, with bituminous in a layer on top. With anthracite having a low coefficient of friction on the bottom, the entire load slides out in a body when the truck dumps; mixing takes place as the load flows to the ground or the bin floor. Weighing is unnecessary; bulk measurement proves satisfactory. A mark on the inside of the truck body at ⅓, ½ or ⅔ its height serves for loading these proportions of anthracite.

### *Loading in Barges*

A similar layer-cake method of barge loading proves successful. As used by one large power company for more than a year, alternate cars of anthracite and bituminous were loaded over the entire hatch area. The clamshell shovel for unloading barges provided the necessary mixing as it cut through the various layers of anthracite and bituminous.

With rail delivery, dumping alternate cars to a common pile or to a single bunker provides a good preliminary mix. At plants where run of mine bituminous passes through a crusher, coal can be mixed before or after crushing but coal delivered in layers would certainly be well mixed as it passed through the crusher.

Plants wih two conveyors can secure good mixing by loading anthracite in the correct proportion to one conveyor and bituminous to the other. Mixing results when the conveyors discharge into the main conveyor or other piece of coal-handling equipment. In a plant equipped with a bucket conveyor, two loading points were used, one for anthracite and one for bituminous. Loading drums were set so that three buckets received bituminous and one received anthracite, and so on. This produced an accurate

## NICKEL AIDS THE AERONAUTICAL INDUSTRY

# *to KEEP 'EM FLYING!*

The design engineers of the aeronautical industry have repeatedly met demands for improved aircraft to serve on world-wide fighting fronts. At the same time the industry has been able to turn out huge quantities of highly complex precision mechanisms on a mass-production basis.

Since the pioneer days of the aviation industry, it has made extensive use of materials containing Nickel for engine and fuselage parts. In these applications the industry's engineers have developed to the fullest extent the useful and unique properties contributed by Nickel to the materials commonly used in aircraft construction.

The continued widespread use of Nickel reflects confidence based on innumerable satisfactory performance records.

On all fronts, pilots and maintenance crews are learning what metallurgists long have known. Properly used, a little Nickel goes a long way toward assuring the dependable performance of aircraft. From valves to drive gears, and from crankshafts to manifolds, modern aircraft perform more dependably because of the added strength, toughness and resistance to corrosion Nickel imparts to other metals.

The technical staff of International Nickel has been privileged to cooperate with the aeronautical engineers who have accomplished so much toward the improvement of aircraft. These engineers and metallurgists offer counsel and data to all who desire assistance in the selection, fabrication and heat treatment of ferrous and non-ferrous metals.

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**THE INTERNATIONAL NICKEL COMPANY, INC.,** *67 Wall St., New York, N.Y.*

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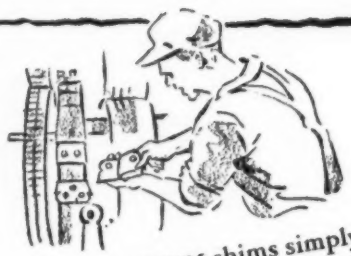

LAMINUM shims simply *peel* for precision adjustment, right at the job . . . release men and machines from old-fashioned shim-fitting, for more productive work.

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LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT

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25% mixture at the discharge point.

The number of ways of securing the needed intimate mixture is almost as great as the number of plants and handling systems, because these vary so widely. Each represents an individual problem, requiring engineering study, but experience indicates that mixing methods can usually be devised to fit the setups found in most plants.

## Engineers' Bookshelf

(*Continued from page* 128)

Added to its importance, bearing lubrication involves many complications because of the very nature of lubricating oil and the mechanics of an oil film between a journal and its bearing. These problems have received exhaustive scientific study but nearly all our information on selecting and applying lubricants results from practical trial-and-error. No convenient formula has been devised that provides rule-of-thumb answers to everyday problems. For that reason, the subject is treated with practical clarity and without mathematical analysis. First eleven chapters deal with production of lubricating oils, their refining, specifications and characterisics; then follow two chapters on application of lubricants to bearings. Eighteen chapters treat lubrication of specific machines, such as anti-friction bearings, steam engines, steam turbines, hydraulic turbines, air compressors, internal-combustion engines, gears, etc. The book closes with a chapter on each of the following: hot-oil circulating systems, white oils, oil purification and reclaiming, greases, and rust prevention with petroleum products. The treatment, practical throughout, makes this book useful to everyone dealing with lubrication problems.

### Arc Welding

STUDIES IN ARC WELDING—DESIGN, MANUFACTURE AND CONSTRUCTION—1943. *Published by The Jas F Lincoln Arc Welding Foundation, P O Box* 5728, *Cleveland, O.;* 1295 *pp.;* 9x6 *in. U. S. price* $1.50; $2.00 *elsewhere postpaid.*

In the 1940–42 Industrial Progress Award Program, engineers, designers, works managers, superintendents, executives, foremen and other technicians submitted 98 papers that constitute what is said to be the most comprehensive and complete collection of design studies on arc welding published since the Foundation's 1939 volume. Most of the 1007 illustrations are actual photos.

Divided into nine sections, the book


This *New* OAKITE DIGEST Gives You

This specially-prepared 16-page Power Plant Digest contains the type of war-data you want . . . practical ANSWERS to 65 commonly - recurring maintenance cleaning, de-scaling, paint stripping and related problems.

How was it compiled? By condensing the successful, current experience of more than 300 steam, internal combustion and central station power plants. In its pages you will find specially designed techniques and procedures for expediting maintenance of heat exchangers, Diesel engine cooling systems, lube oil coolers, transformers, oil pre-heaters and many other types of power plant equipment. On each job is given the material to be used, the method followed and the advantages gained.

**SEND FOR YOUR FREE COPY**

If you are responsible for any aspect of power plant equipment maintenance, you should have a copy of this valuable, illustrated Digest. Send for your FREE copy TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.

*Technical Service Representatives Located in All Principal Cities of the United States and Canada*

OAKITE Buy Bonds for Victory
*Specialized cleaning*
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

# pressure GAGES

## PRESSURE GAGES FOR TOMORROW'S INDUSTRY

Today's battles of war are being won by those who are most intelligently using the best instruments of war.

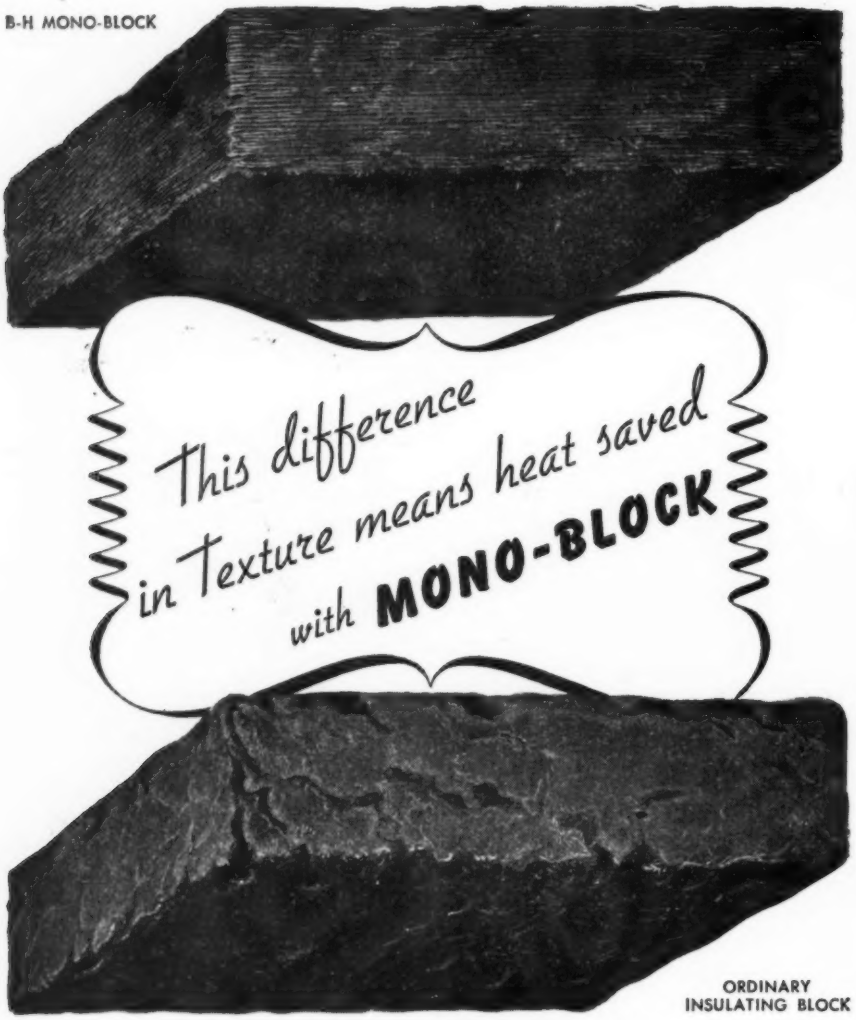
Tomorrow's battles within industry will likewise be won by those adapting to their own problems the best available instruments of industry.

The Clapp Acragage is a precision-built indicating pressure gage with refinements and improvements that are exclusive. It is offered in standard models, or can be custom-built to your individual needs.

The highly trained Clapp Experimental Department will gladly work out with you now, exactly the gage you need to jump into the Post-War Period with a headstart on competition.

**CLAPP INSTRUMENT COMPANY**
WEBSTER MASS.

Clapp WEBSTER MASS




Note how the long, straight fibres in B-H Mono-block are interwoven in layers by an exclusive, patented process. Here is the reason why Mono-block is lighter, more efficient. A veritable army of millions of tiny air-cells in each block holds back the heat and prevents its escape.

Mono-block is a one-block insulation, effective over the full temperature-range up to 1700° F. This means substantial savings in installation costs. Its felted surface yields to rivet-heads, welds, and other surface irregularities without cracking or breaking. Made from *black* rockwool, it is high-temperature-resistant and has exceptionally low thermal conductivity. It will pay you to investigate B-H Mono-block. Send for sample and new bulletin.

*Baldwin-Hill Co., 575 Klagg Ave., Trenton 2, N. J. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.*

**Baldwin-Hill**

BH COMPANY

**HEAT & COLD INSULATIONS**


covers these fields: automotive, aircraft, railroad, watercraft, structural, furniture and fixtures, commercial welding, containers and, last, machinery, to which 565 pages and 421 illustrations are devoted.

Each of the 113 technicians applies himself individually to a specific design study involving arc welding. Each study includes designs, calculations, procedures and other pertinent information showing how to obtain the advantages attributed to arc welding. Many studies involve war-plant production, but principles and practices are applicable to postwar industrial design and manufacture.

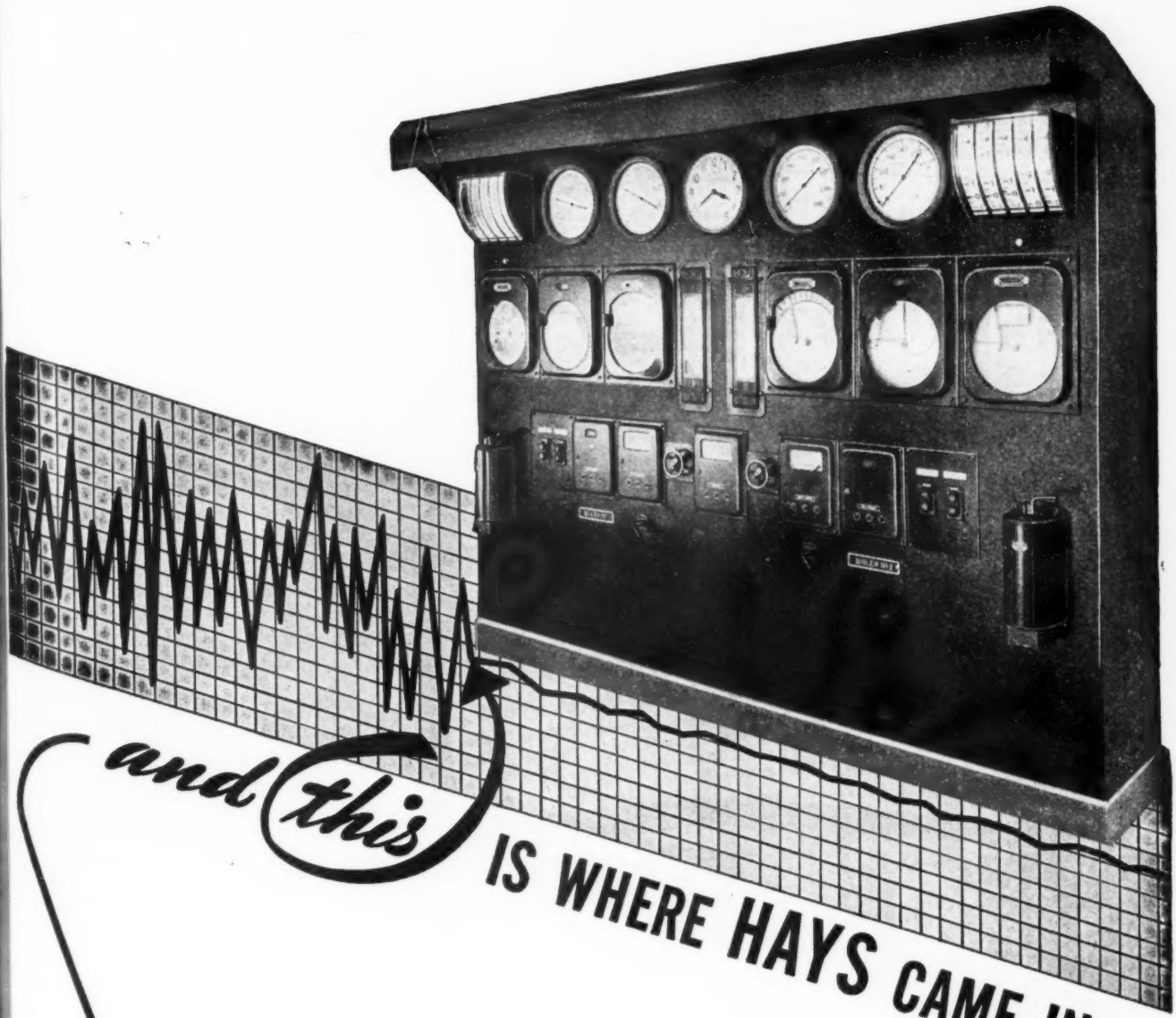
## Good English

THE ENGINEER'S MANUAL OF ENGLISH (*revised* 1943) *By W O Sypherd, professor of English, University of Delaware; Alvin M Fountain, associate professor of English, North Carolina State College of Agriculture and Engineering; Sharon Brown, associate professor of English, Brown University. Published by Scott Foresman & Co, Chicago;* 503 *pages,* 7¾x5 *in., cloth,* $2.50.

Here is a guide to good English for the engineer writer and for him alone. The chapter on correspondence is a treasure for the pen-shy. It outlines the essentials of a good letter—gives tips on making yours clear, concise, and accurate while not forgetting the importance of underlying courtesy and character. Gives sample letters that are easy to follow for applications, invitations, requests for advice or information, sales letters, orders, claims, followups and similar subjects.

Report writing, to which 99 pages are devoted, has valuable pointers for the student and for the engineer who wants to brush up on both information and examination reports. Tells how to write up tests, construction progress, routine information and longer recommendations on projects involving large expenditures; how to assemble and organize data; how to write short concise statements for busy executives interested only in the highlights of an investigation, as well as longer, detailed analyses for engineers who want to know how tests are conducted and data compiled. Many specimens are included that cover the main steps of good report writing.

There are do's and don'ts on vocabulary study, spelling, idiomatic phrases, accuracy, force, jargon. Punctuation, abbreviations, capitalization and how to write numbers, large and small, are explained. Other chapters tell about writing for technical magazines, public speaking, Army and Navy reports, etc.



*and this* IS WHERE HAYS CAME IN . . .

THE MODERN SYSTEM *It's Electrical*

STRAIGHTENING out the fluctuating steam pressure line is one of the functions of Hays Automatic Combustion Control.

Maintaining constant steam pressure, developing low cost steam, saving fuel, reducing man-hours are a few of the common sense results being achieved daily in industrial steam power plants by Hays Control.

These results are particularly desirable in an all-out drive for greater production of war material. And greater production starts at the source of power—power to drive the machines that turn out the tanks and planes and battle ships.

Hays Automatic Combustion Control enables you to get the most out of your present steam generating equipment—with safety.

Send for full particulars.

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

# Make Good Piping Better

with

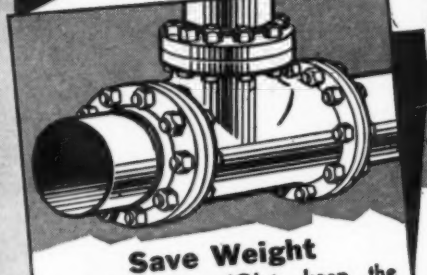
## WELDOLETS • THREDOLETS

**3 Types Meet Every Need**

WeldOlets for butt welded branch connections.

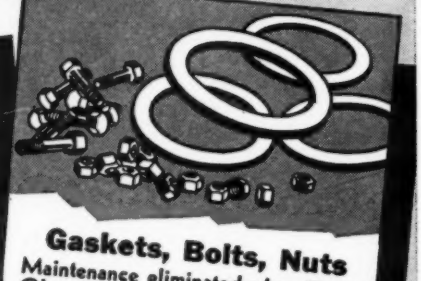
ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type welded branch connections.



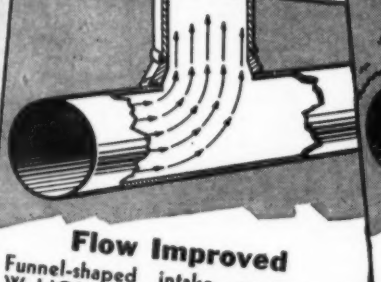
**Save Weight**

WeldOlets, ThredOlets keep the weight of any piping system to a minimum. Fewer flanged joints mean less possibility of leaks.



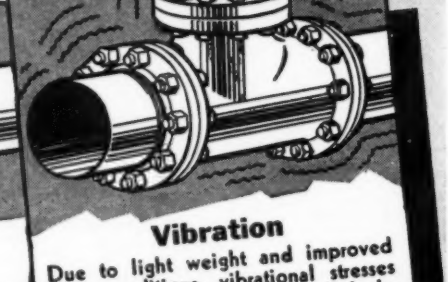
**Gaskets, Bolts, Nuts**

Maintenance eliminated when WeldOlets, ThredOlets are used—no need to change gaskets, tighten nuts and bolts.



**Flow Improved**

Funnel-shaped intake aperture of WeldOlets, ThredOlets improve flow conditions, reduces turbulence and friction.



**Vibration**

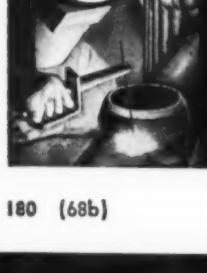
Due to light weight and improved flow conditions, vibrational stresses are reduced, possibility of leaks eliminated when WeldOlets, ThredOlets are used.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line—and always with ease and economy. They are equally well adapted to pre-fabricated or "on-the-job" assemblies. Stocked for all standard pipe sizes up to 12" in size-to-size and reducing sizes—and can be supplied on special order for pipe up to 24". Stock fittings are drop forged steel, but to meet special conditions will be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for your copy today.

*Forged Fittings Division*

**Bonney Forge & Tool Works, Allentown, Pa.**



Star Awarded July 10, 1943

WELDOLETS • THREDOLETS

TRADE MARKS - REG U S PAT OFF

*Welded Outlets for Every Piping System*


## Power Lines

(*Continued from page* 134)

Japs sank her in the harbor, and seized the U. S. gunboat "Wake." A few hours later they took over the entire city, including the power house and electrical distribution system.

All foreign employes of the company were ordered to stay on the job to maintain essential services to the population.

Surprisingly enough, Mr Rummel reports, the big Shanghai plant kept on generating power under Jap domination with no major shutdowns or power failures, although the underpaid and underfed Chinese workers in the plant showed increasing unrest. Neither he nor other foreign executives could do anything to relieve this distress; the Japs held the purse strings, paying Mr Rummel the equivalent of $20.00 (U. S. money) per month, and Chinese laborers in proportion.

As the months rolled by, one after another the American and British executives and supervisors were taken away to concentration camps, politely labeled "Civil Assembly Centers." By June, 1943, all were gone but Mr Rummel, who still worked in his laboratory without molestation—perhaps because the Japs dared not operate the plant without his technical knowledge.

Mr Rummel did not find the Japs particularly efficient in business or technical operations. The Shanghai plant kept running under their control, he said, partly because it was always staffed mainly by "foreigners"—at the top American, British, Russians, Danes, Germans—at the bottom hundreds of well-trained Chinese mechanics in the extensive plant workshops.

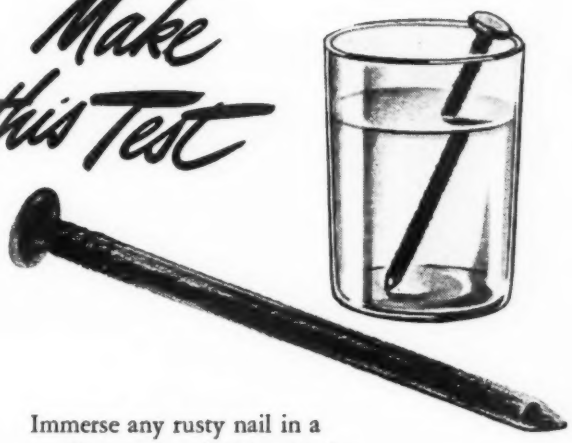
While seeking to establish himself in America, Mr Rummel's address will be 4932 Penn St, Philadelphia 24, Pa.

**Solid Fuels Adm** recently announced a program to meet urgent industrial and domestic needs by using existing emergency stockpiles. To make increased shipments to **essential industries** and **householders with insufficient coal**, the program, which covers nearly all bituminous coal produced in eastern U. S., reduces shipments to industrial plants and railroads that have large stocks. This action is expected to free about 5 million tons monthly for the next few months.

Stock limitations are set forth in Regulation 10. Further voluntary action by producers, wholesalers and consumers to lower shipments below these

# What to do about Rust?

## Make this Test



Immerse any rusty nail in a small quantity of Cities Service Rust Remover. If badly rusted, allow to remain for several minutes. You can actually see the rust dissolve.

## See the Results

Remove nail and wipe dry with cloth or tissue. Note the complete absence of rust and the way the original surface reappears.

**CITIES SERVICE RUST REMOVER** has been tested for four years throughout a small, highly industrialized area in the East, where it has earned a unique reputation for performance. RUST REMOVER is a clean, clear liquid, practically odorless, non-inflammable, easily applied, and harmless to handle by those not allergic to specific chemicals. It is fast-acting, and, although heating somewhat accelerates results, general application is recommended at normal temperature (60°-90°F.). RUST REMOVER is effective on chromium, copper, aluminum, steel and iron.

## 5 Big Advantages

1. Non-Inflammable
2. Harmless to Normal Skin
3. Makes Metals Chemically Clean
4. Removes Rust by Chemical Action
5. Free from Muriatic, Sulphuric, Nitric and Oxalic Acids or Cyanide.

***See a Free Demonstration of Rust Remover on Your Own Equipment.***

*(Available only in Cities Service marketing territory EAST of the Rockies.)*

**MAIL THIS COUPON TODAY!**

**CITIES SERVICE OIL COMPANY**
Room **113**
Sixty Wall Tower, New York 5, New York

Gentlemen: I'd like to test RUST REMOVER on my own equipment FREE OF CHARGE. Send me details.

Name.....

Company.....

Address.....

City.....State.....

CITIES SERVICE OILS — ONCE-ALWAYS

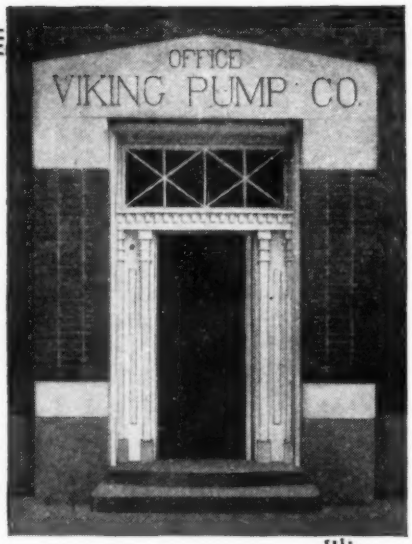
**CITIES SERVICE OIL COMPANY**
NEW YORK · CHICAGO

IN THE SOUTH
**ARKANSAS FUEL OIL COMPANY**
SHREVEPORT, LA.

# APPRECIATION
## ...Isn't Dead

War brings many casualties. But Viking Pump Company has not and will not permit appreciation of your business to be listed among them.

It's true the Army and the Navy have been Viking's top customers since Pearl Harbor. And we're proud, of course, to be called on to do our bit toward winning the War. But we'll always remember, with deep appreciation, that it was the patronage, the confidence and the loyalty of civilian customers, cemented throughout the years, that helped Viking attain a position of leadership.



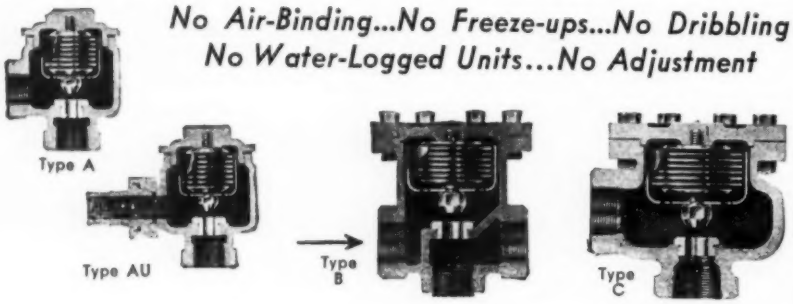

We look forward to Victory . . . to the days of Peace when we shall again be privileged to provide customary efficient service for civilian customers, large and small, in many industries. In the meantime, keep up-to-date on Viking Rotary Pumps. Write today for our Catalog 42-G, which gives you illustrations, descriptions and complete specifications on every pump in the Viking line. It's FREE and will be sent postpaid to you by return mail.

VIKING PUMPS — FIRST IN AMERICA

**VIKING Pump COMPANY**
CEDAR FALLS, IOWA

★ Enormous Water and Air Discharging Capacity
★ Positive Intermittent Valve Action

*No Air-Binding...No Freeze-ups...No Dribbling*
*No Water-Logged Units...No Adjustment*




# NICHOLSON *Thermostatic Industrial* TRAPS

**Frequent intermittent discharge of condensate creates better circulation of steam in kettles, platens, driers, unit heaters and other equipment, thus inducing rapid and maximum heat transfer efficiency, and greatly increasing production. Bulletin No. 843 illustrates and describes all five types of Nicholson Thermostatic Traps. Sizes ¼" to 2". Pressures to 225 lbs.**

**W. H. NICHOLSON & CO., 125 OREGON ST., WILKES-BARRE, PA.**

*TRAPS • VALVES • STEAM SPECIALTIES*


standards will make more coal available during the coldest weather. To meet changing conditions, bituminous coal producers will make monthly recommendations for adjusting standards.

Effective Dec 1, industrial plants and railroads, with coal storage equivalent to more than 25 days' consumption and public utilities with more than 40 days', must reduce orders to 75% or less of monthly burning requirements. Because of transportation hazards, Canadian consumers and those supplied by tidewater in New York Harbor and New England may maintain an extra 15 days' supply above the 25 and 40 days.

Industrial plants, railroads and utilities with stocks below certain specified days' supply may order enough coal to build storage piles to a safe and practical level in a few months. Producers are permitted to ship without restriction to customers having more than the established stock-pile protection when orders under the program cannot be secured.

Excluded from restriction is coal for vessel or bunker fuel, for coke manufacture, for gas or chemical manufacture, and for foundry, malleable or other metallurgical purposes. Another program being studied would assure special coals for coke manufacture in the steel industry and for gas production. Consumers supplied from commercial docks on Lake Michigan's west bank and from Lake Superior are not affected because they operate under another program.

**At the American Welding Society's** annual meeting, the Miller Medal was awarded to Dr. David S Jacobus, retired consulting engineer of Babcock & Wilcox, for the most conspicuous contribution to research, standardization and advancement of welded construction.

## APPOINTMENTS

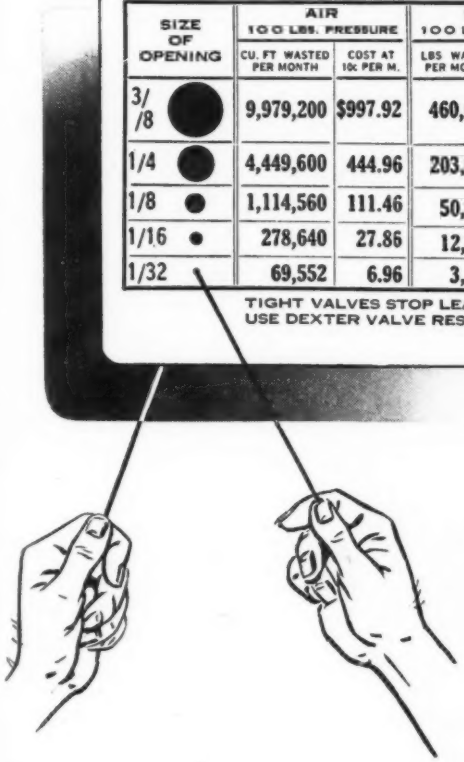
**Westinghouse Electric & Mfg Co** announce the following appointments: Two new managers in the industry dept are **C F Lloyd,** manager of the general contract dept and **Tomlinson Fort,** manager of the central station dept. **H W Tenney** will help coordinate vital wartime engineering activities, as assistant to Thos I Phillips, vice-president in charge of the Pittsburgh divisions. **Chas H Weaver,** as manager of the newly formed marine dept. will direct all commercial activities.

**Combustion Engrg Co, Inc,** appoint **Otto de Lorenzi** director of education. They have elected **Wilbur H Armacost** vice-president to succeed the late F H Rosencrants, in charge of marine activ-

THE COST OF LEAKS

| SIZE OF OPENING | AIR 100 LBS. PRESSURE | | STEAM 100 LBS. PRESSURE | | WATER 40 LBS. PRESSURE | |
|---|---|---|---|---|---|---|
| | CU. FT WASTED PER MONTH | COST AT 10c PER M. | LBS WASTED PER MONTH | COST AT 60c PER M. | GAL. WASTED PER MONTH | COST AT 15½c PER M |
| 3/8 | 9,979,200 | $997.92 | 460,000 | $276.00 | 692,400 | $108.00 |
| 1/4 | 4,449,600 | 444.96 | 203,000 | 121.80 | 307,700 | 48.00 |
| 1/8 | 1,114,560 | 111.46 | 50,500 | 30.30 | 76,900 | 12.00 |
| 1/16 | 278,640 | 27.86 | 12,750 | 7.65 | 19,200 | 3.00 |
| 1/32 | 69,552 | 6.96 | 3,175 | 1.91 | 4,800 | 0.80 |

TIGHT VALVES STOP LEAKS—SAVE MONEY
USE DEXTER VALVE RESEATING MACHINES



# Wire Drawing Costs Money in Power Plant Valves

That small valve leak opening — the equivalent of a $\frac{1}{32}$-inch hole, for example — can cause big losses in steam, air or water; and in certain process lines a small leak may be really serious. Unless the leak is repaired promptly, it will grow in size until a complete overhaul or a new valve is needed.

## Reseat Early, the Low-Cost Dexter Way

The only sensible way to stop "wire drawing" and leak losses is to reseat the valve, in the early stages, right on the line, with Dexter Valve Reseating Equipment. No new parts will be needed, little time will be lost, and the labor cost will be negligible.

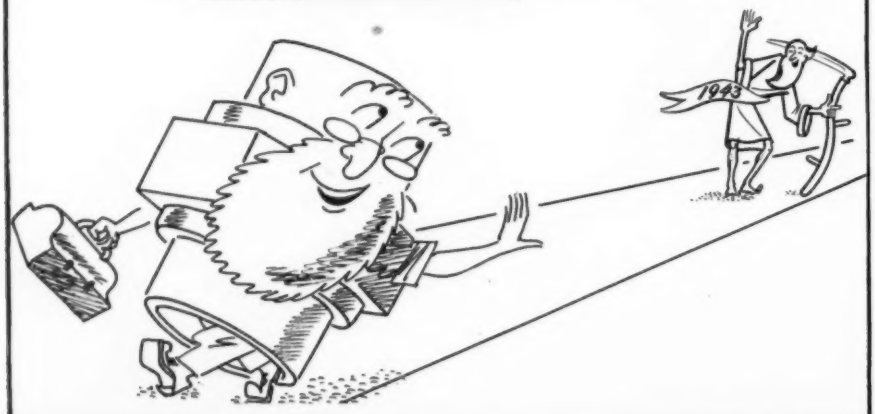
Tell us about your leaky valves. We'll tell you the Dexter equipment needed to stop your troubles — permanently.

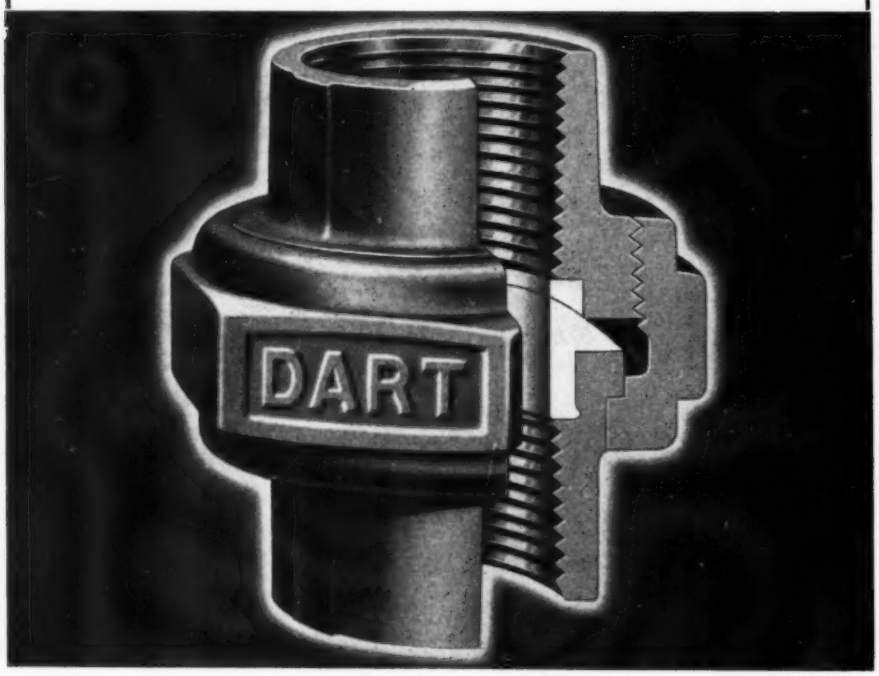
7

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

# EXIT 1943

## ...but Old Dart Unions Still Carry On




**The old year has gone . . . but old Dart Unions, even though they have already seen a lot of service, are still very much in the picture . . . ready and able to go back to work and give more dependable, economical performance.**

**This extra Dart Life is largely due to these important factors. First, Darts have matched bronze seats, ground to true-ball surfaces. Second, Dart bodies and nuts are made of high test air refined malleable iron that resists rough handling and rust.**

**Help give the New Year a good start by making another search of your plant for used Dart Unions to put back to work. And if you need *new* Darts, get in touch with your supplier promptly.**

DART UNIONS

**E. M. DART MFG. CO., PROVIDENCE, R. I.**

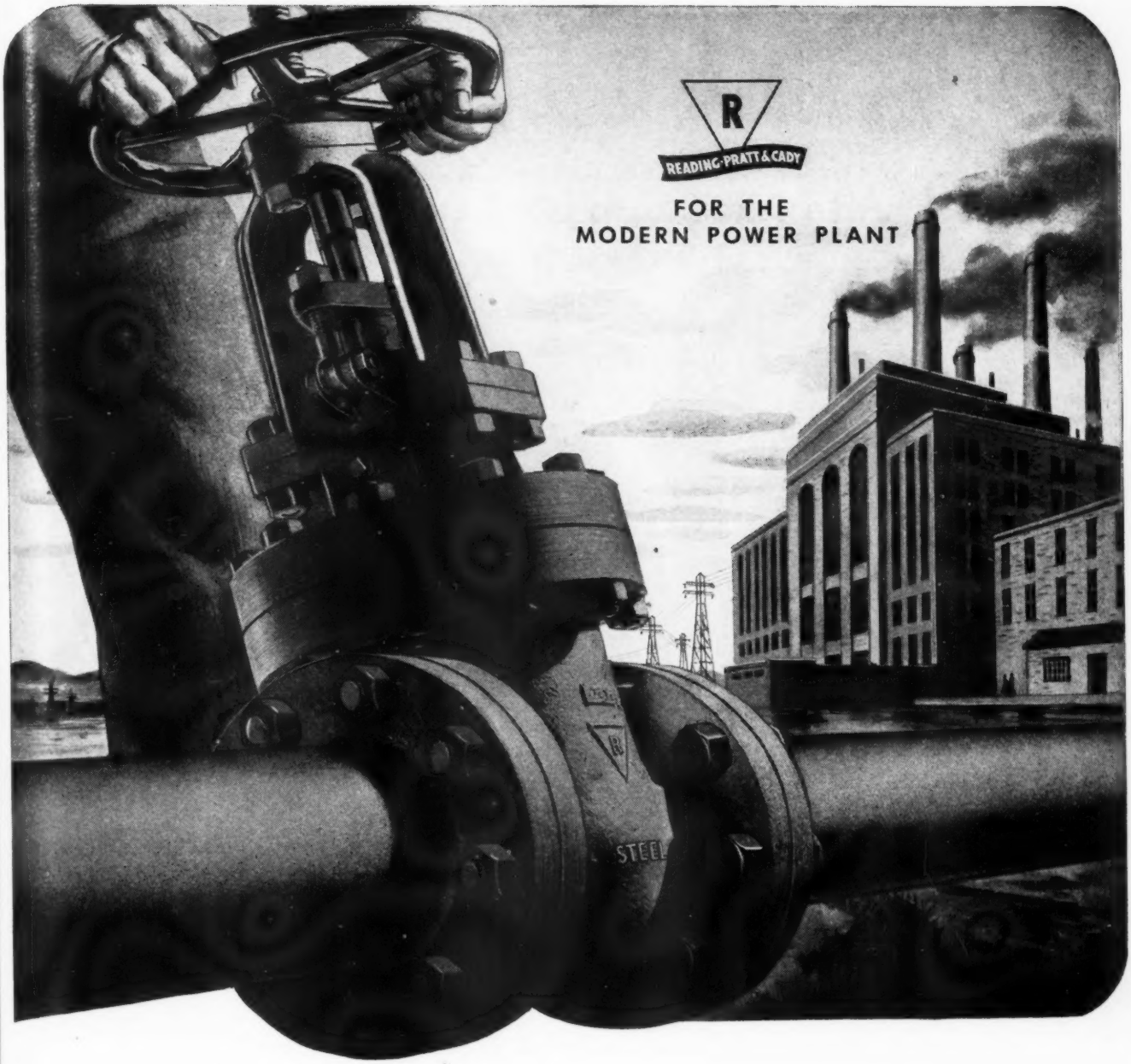

ities. Their marine dept names **David M Schoenfeld** asst manager in charge of proposal engineering, development of technical data and special heat transfer equipment; **J. R. Kruse** chief engineer in charge of execution of contracts with development of design standards, participating in development and research on marine equipment; **W H Groundwater** transferred from New York to San Francisco as resident marine engineer on the Pacific coast.

**Harry S Tweedy** is appointed manager, field service div, **Detrex Corp.** **Stuart M Crocker** has been elected president, **Columbia Gas & Electric Corp.** He succeeds **Edw Reynolds** who will devote his time to the supply div of Office of the Surgeon General of the Army. **Builders-Providence, Inc,** announce that **E W Gray** has been transferred from their Philadelphia to their Chicago office. **W S Codell** returns to their Philadelphia office. **J Murray Whitworth** has been appointed sales representative, Pittsburgh, **Jenkins Bros.**

**Allis-Chalmers** announce that **Scherer Electric Co, Inc,** will distribute their equipment in central and eastern Indiana. **Chester F Conner** has been named asst general manager and **Fred Lang** merchandise manager, industrial products sales div, **B F Goodrich Co.** The new San Francisco branch of the **Cooper-Bessemer Corp,** under local supervision of service representative **John G McKissick,** will facilitate installation and maintenance of diesels in Army and Navy vessels constructed in northern Calif.

**Blackmer Pump Co** announces the opening of a new Philadelphia office, in charge of **B Dunkley.** **Wheelco Instruments Co** announce that **Cochrane Steam Specialty** will serve with **Geo W Hall** as the Boston representative. **C L Clark** is in charge of the Buffalo, N. Y. office; **Chas D Mount** is sales and service representative for southern Ohio and northern Ky., with headquarters in Cincinnati; **H E Holling** represents the company in Peoria; **Lang Co,** Salt Lake City, is sales and service representative in Utah, Idaho, Wyoming and Nevada. **Tube Turns** announce that **T H Pike, Jr,** district manager, Pacific coast area, now has headquarters in San Francisco; **John M Hartley** is in Seattle, Wn; the Los Angeles office has been closed.

**Quigley Co, Inc,** announces removal of their offices to 527 Fifth Ave, New York, 17, N. Y. **Ransome Machinery Co** is now a wholly owned subsidiary of **Worthington Pump & Machinery Corp.** **The Frederick Post Co** announces that




● A wealth of "know how" and valuable new methods have been fried out by the heat of the most intense production period this organization has known since its first days in 1878. . . . To be sure, most of the valves we have made have gone directly to the war effort. But as soon as the materials pressure upon the Nation and the demand for this production from us ease up, you will find great gains reflected in the very valves we will be producing for you.

**READING-PRATT & CADY**

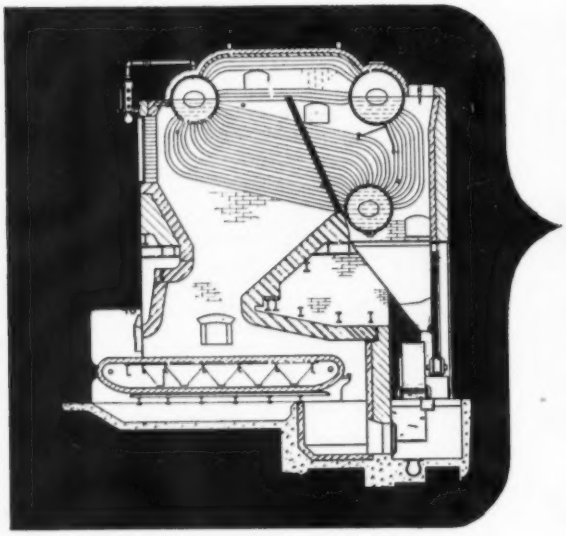
*MANUFACTURERS OF*
READING CAST STEEL VALVES AND FITTINGS
PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco

**A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT**

# UNION

FILE THESE UNION ADS FOR REFERENCE



H-TYPE
A-TYPE
L-TYPE
RADIANT TYPE
4-DRUM
O-TYPE
LONG DRUM
CROSS-DRUM
UNIVERSAL STEEL-CASED
UNIVERSAL BRICK-SETTING
HORIZONTAL RETURN TUBE
LITTLE GIANT
HEATING

## L-TYPE BOILERS

INVESTIGATE the complete line of Union Boilers. Type L, one of 13 Union basic Boiler designs, is a compact Low Headroom Boiler that will carry high ratings efficiently. Both Top Drums at the same level (neither submerged) provides the maximum steam disengaging area and a fast steaming rate through greater inclination of the tube bank. Steam crossover tubes exposed to the gases carry steam only and can be arranged to provide a moderate amount of initial superheat. Booklet L-3 tells the complete story. *Write for it today.*

UNION IRON WORKS ★ ERIE, PA ★

# BOILERS

*PRESSURE VESSELS • PLATE FABRICATION*


the **20th Century Blue Print Co**, San Francisco, has taken on their line.

**General Electric Co** announces four appointments in the electronics dept: **J W Whiteside**, buyer in the tube div; **E H Fritschel**, sales manager of transmitting tubes; **H J Mandernach**, sales manager of receiving tubes; **R P Whitmyre**, assistant to R J Bahr, purchasing agent of the dept. **Wickwire Spencer Steel Co** names **Robert T Dunlap** assistant to the president. He is an authority on plant installations, production and operation. **Joseph L Dudley** joins **Cochrane Steam Specialty Co** in Boston, Mass. **J Handly Wright** has been made director, dept of industrial and public relations, **Monsanto Chemical Co.** **U. S. Rubber Co** appoints **Harold I Beadle**, chemical engineer, as sales manager for new products of Naugatuck chemical div.

**Fairbanks, Morse & Co** have made these changes in personnel: **O O Lewis**, formerly in Atlanta, Ga., is asst genl sales manager in Chicago; **V O Harkness**, from Dallas, Texas, is now manager, diesel engine sales div, Chicago; **H J Renken**, of oil field div in Dallas is also branch house manager; **J S Peterson**, scale dept, has been made branch manager in Cincinnati; **G N Van Epps**, of Chicago diesel dept, has been made branch manager in Atlanta, Ga.

**Falk Corp** announces that **Thomas F Scannell** is general sales manager, in charge of all products including steel castings. **John S Wilkinson** is asst sales manager in charge of foundry sales. **Fred J Vogel**, formerly consulting transformer engineer for Westinghouse has been appointed professor, electrical engrg, **Ill. Institute of Technology**. **U. S. Rubber Co** has appointed **Harold J MacDonald** manager of jobbing sales and Howard F Johnson manager of branch sales in New York City.

## OBITUARIES

**Charles B Davis**, former manager of General Electric's New England district died Oct 22 at the age of 82.

**Frank A Ross**, senior vice-president, Stewart-Warner Corp, died suddenly Nov 17 at the age of 60.

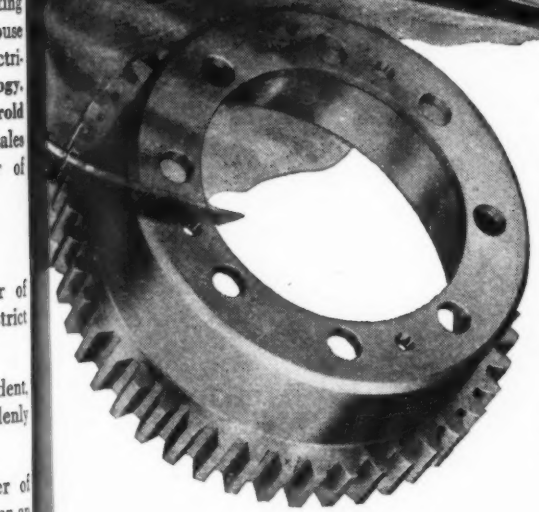
**George G Gebhart**, sales manager of The Hotstream Heater Co, died after an illness of more than a year.

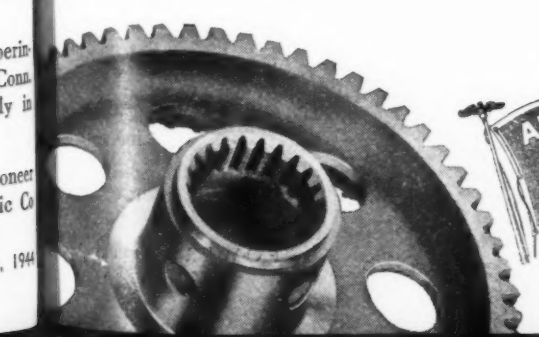
**Albert Gesner**, former assistant superintendent, Montville steam plant, Conn. Light & Power Co, died recently in Florida.

**George F Morrison**, 76, Edison pioneer and a director of General Electric Co

# back of them ...

# *the shadow of* GEARS





THERE is no substitute for "soup" any airman will tell you—"soup," the concentrated energy that giant Pratt & Whitney engines develop to speed the mighty Hellcat on its missions of destruction.

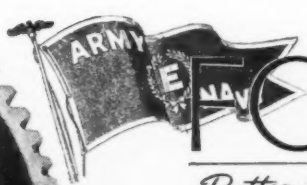
And back of these planes—back of the giant 2,000 horsepower engines that power them are gears. Gears of such extreme precision—held to such close tolerances—that each one is a modern marvel of engineering and manufacturing perfection.

Foote Bros. take pride in the production techniques that make such high precision possible—pride in the manufacturing "know-hows" that are responsible for the tremendous quantities of these gears rolling off production lines in three of its huge plants.

And Foote Bros. are looking ahead to the day when these precision gears will mean a new approach in the economical transmission of power in peacetime machines. Already on the drafting boards of many manufacturing plants are machine tools and construction equipment—combustion engines and other machinery that promise new efficiencies because of the precision gears they will employ.

FOOTE BROS. GEAR AND MACHINE CORPORATION

5225 S. Western Blvd. • Chicago 9, Illinois




FOOTE BROS.

*Better Power Transmission Through Better Gears*

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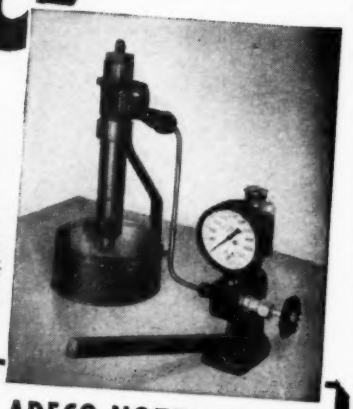
DIESEL FUEL
INJECTION EQUIPMENT



**ADECO NOZZLE TESTER**
*For Economical Maintenance*

America's most widely used Nozzle Tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors. Avoids costly delays and possible damage to engine. Best for economical maintenance. Write for new bulletin.

Throughout the diesel industry, Adeco stands for the finest in fuel injection equipment. Years of experience in pioneering equipment for America's diesel needs have resulted in an outstanding line of fuel injection pumps, nozzles and nozzle holders. Today's performance of this dependable equipment merits your confidence for tomorrow's requirements.

AIRCRAFT & DIESEL EQUIPMENT CORPORATION
4401 North Ravenswood Avenue • • Chicago, Illinois


since 1922, died on Oct 21. He was a leader in the incandescent lamp field.

**George A Bartlett,** 68, for ten years chief engineer, municipal auditorium, Worcester, Mass., died on Nov. 27.

## CURRENT ARMY E NAVY AWARDS

**Army-Navy "E" flags** now fly over these three industrial plants: Yale & Towne Mfg Co, Philadelphia division; Manhattan Rubber Mfg Division of Raybestos-Manhattan, Inc; Fitzgibbons Boiler Co, Inc.

**A white renewal star** has been added to "E" pennant of: A M Byers Co, Ladish Drop Forge Co; American Foundry Equipment Co; Whiting Corp; Independent Pneumatic Tool Co. **Second white renewal star** was awarded to The Electric Storage Battery Co and Nordberg Mfg Co.

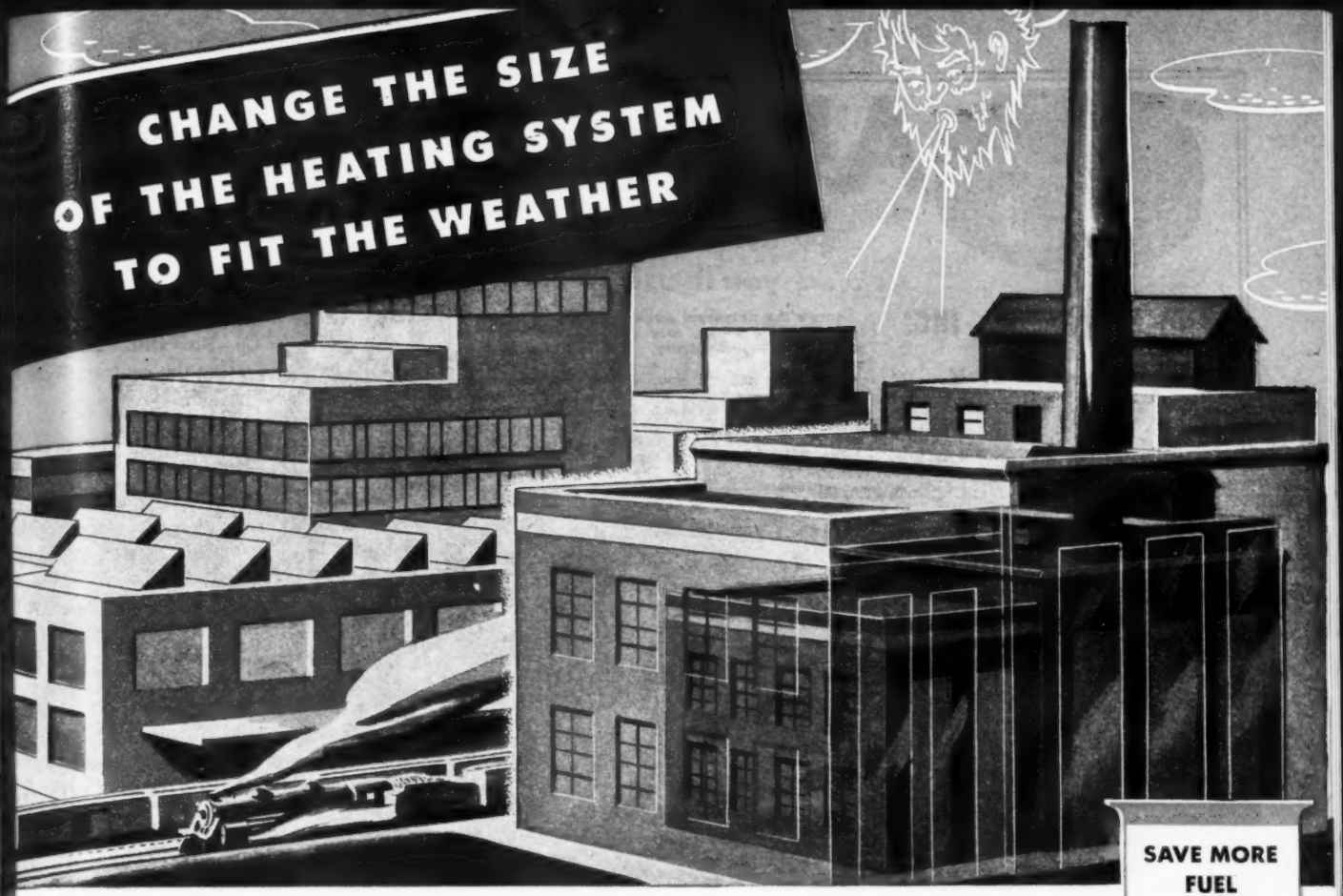
**Maritime "M" pennant** was awarded recently to Pottsville Castings and Machine Shops, Inc, subsidiary of Condenser Service & Engrg Co, Inc. **An additional Maritime star** has been added to the pennants of Nordberg Mfg Co and the Powell Co.

## POWER's History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers and Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review, of Cleveland,* and *The Engineer,* of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering and The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. All rights to the preceding titles reserved.




# with the JOHNSON Electronic *DUO-STAT*

As outdoor temperatures vary, the Johnson Electronic Duo-Stat is the "go-between" that literally "changes the size of the heating system" so that indoor temperatures may be maintained automatically at a constant level without wasting time or fuel.

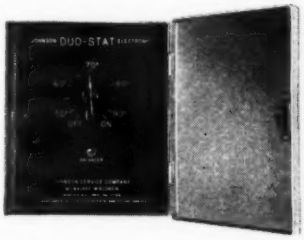
The temperature-sensitive elements are located on the outside of the building and on the heating system. By controlling the heat at its source, the Johnson Electronic Duo-Stat maintains the required temperature of the heating system at all times.

Johnson Electronic Duo-Stats may control automatic firing devices or a valve on the "street steam" main. In larger buildings, the heating system may be divided into zones, the number depending on use, occupancy, exposure and other factors. Each zone may be controlled separately at different temperature levels.

Whatever your temperature or air conditioning control problem . . . in industrial, commercial, institutional or office buildings . . . get in touch with the nearest Johnson office. A staff of trained installation men is located in each principal city.

## FOR SPECIAL APPLICATIONS REMEMBER PNEUMATRONICS

*Pneumatronics, developed by Johnson, is a combination of the best in electronic circuits, coupled with pneumatic temperature control equipment. Pneumatronic principles may be applied profitably to certain types of automatic temperature control problems in the industries and for the control of steam and hot water heating.*




Johnson Electronic Duo-Stat, which is connected to resistance bulbs on the heating system and to a temperature-sensitive element on the outside of the building.

**MORE AND MORE IN '44 BUY WAR BONDS**

# JOHNSON SERVICE COMPANY

## MILWAUKEE 2, WISCONSIN

Temperature and Air Conditioning Control Equipment

Direct Branches in All Principal Cities

# ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and

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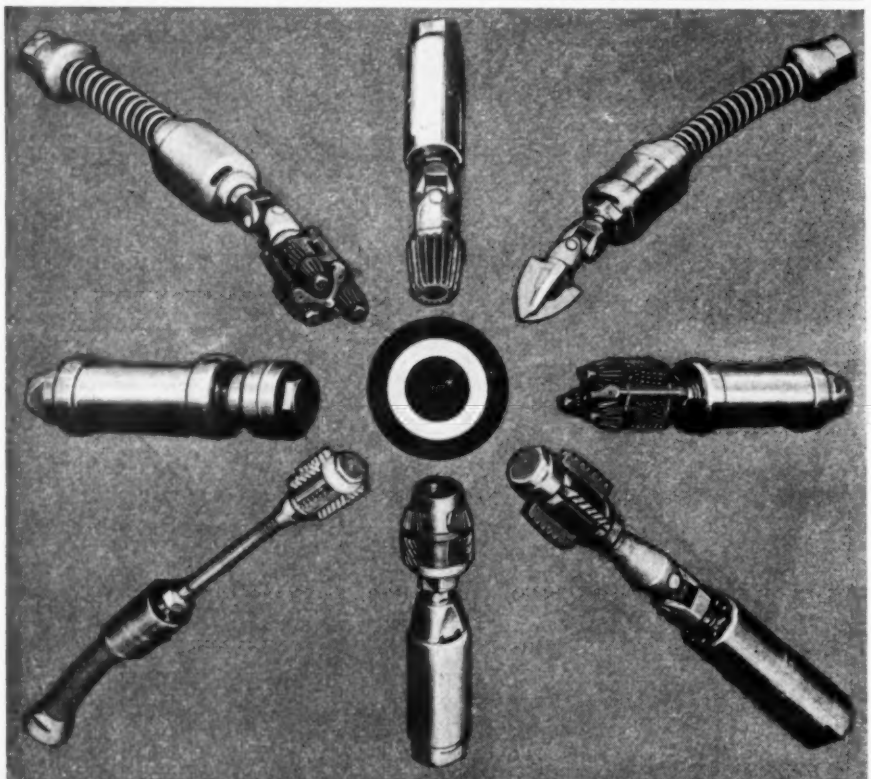
Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.





# YOU CAN KEEP UP-KEEP DOWN WITH WILSON TUBE CLEANERS

Today, more than ever before, it is essential that boilers—like all other mechanical equipment—are maintained at maximum efficiency. Shutdowns for tube cleaning reduce plant production and improperly cleaned tubes necessitate more frequent cleanings. So, whenever a boiler *must* be cleaned it is sound business to always use a tube cleaner which operates at maximum efficiency and which does a *rapid* and *thorough* cleaning job. This will reduce the number of cleanings per year, will keep up-keep down and will increase production.

Wilson Tube Cleaners clean straight or curved ferrous or non-ferrous tubes of large or small diameter faster, better and more economically because they have more speed, more power and more efficiency built into them.

Write for the name of our representative nearest to you, or ask for a copy of our NEW 40-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

INVEST IN AMERICA! BUY WAR BONDS AND STAMPS!

**THOMAS C. WILSON, Inc.**

*PIPE AND TUBE CLEANERS EXCLUSIVELY*

THE WILSON BUILDING

21-11 44TH AVE. LONG ISLAND CITY, N. Y.


**This are welding contest** does not demand a literary style. Perhaps exactly the same welding problem you solved will help a fellow welder do a job easier and faster. Contest closes each month on last business day of month. Entries too late for one month's contest will be automatically entered in next month's. Every month four awards of $25 and 20 awards of $5 will be given. Hobart Bros Co, Box DM 629, Troy, Ohio, are conducting the contest. Write them for further details.

This winter engineering groups throughout the country and groups of technical members of private companies will hear **W H Steinkamp,** asst genl sales mgr, Brown Instrument Co, division of **Minneapolis-Honeywell Regulator Co,** in a series of four talks on practical **aspects of automatic control:** (1) elementary theory of automatic control, with general classification of industrial control mechanisms (2) description of air-operated control mechanisms (3) electric-control mechanisms (4) practical application of control equipment in various industries and processes.

## Power for South America

(*Continued from page* 75)

gage; after present rails have been replaced with heavier ones, 180-ton electric locomotives, said to be the heaviest ever built for meter-gage track, will take the place of the 80-ton units now in use. Ten of these locomotives have been ordered from the United States.

Brazil has abundant waterpower accessible to this line, which in the past has used imported coal or firewood. All available wood has been cut from several miles on either side of the line and fuel must now be hauled for considerable distances. The Sorocabana Railroad has a total length of 1316 miles and serves Pocos de Caldes region of southern Brazil which is an important center for bauxite and other materials.

Brazil now boasts a total of 1343 electric power installations of various types, supplying light and power to 2179 communities. Of Brazil's 1940 installed capacity of 993,742 kw, 732,000 kw represented hydro and 193,140 steam plants. Nearly all the hydro facilities are concentrated in the industrial states of Sao Paulo and Rio de Janeiro.

The Argentine Republic finds itself in a relatively disadvantageous position as far as development of hydro power is concerned because both population and industry are concentrated on the At-

# FREEZE that FIRE!

## with the Randolph "4"

### CARBON DIOXIDE FIRE EXTINGUISHER

**Model FF4-V**

**The Right Extinguisher**—For flammable liquids—motors—electric fires—the Randolph "4" carbon dioxide unit is the fast and safe extinguisher—instantly discharges a penetrating, icy blanket of gas that freezes and smothers the fire completely, preventing its spread and damage to material.

**In The Right Place**—Convenient, portable, light, the Randolph "4" is quickly available. Detaches easily from its wall bracket. Guards periodic work that is fire hazardous. The Randolph "4" provides positive protection—it gets to the fire before the fire gets a start.

**Quick to Operate**—No valves to turn, hoses to adjust, horns to swing up, the Randolph "4" is panic proof—aimed and operated with one hand—the rigid horn permits accurate aim and control—a touch of the thumb—and the fire is out!

**Leaves No Trace**—Randolph "4" carbon dioxide gas is clean and harmless—not a trace of deposit, stain or contamination remains to injure machines, affect electric motors, damage material or destroy chemical formulae. **Convenient to Get**—Prompt delivery to all essential industries. Your supply house probably has the Randolph "4." If not—write, telephone or wire—

## RANDOLPH LABORATORIES, INC.

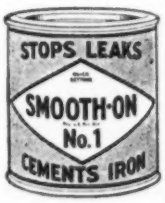
8 EAST KINZIE STREET • CHICAGO 11, ILLINOIS, U. S. A.

This crack, between the air starting valve port and the cylinder head water jacket of a Diesel engine, seemed impossible to repair.

However, the ingenious engineer simply fitted a pipe sleeve into the port, filled the crack with SMOOTH-ON No. 1, also applying a thin coat of SMOOTH-ON No. 3 to cement the sleeve in place. The repair was speedily made and has proved entirely satisfactory.

When you are up against a crack or break in a machine casting, or a leak at a joint of any kind, or a loose part of fixture, think first of SMOOTH-ON. This many-purpose iron repair cement will frequently enable you to make repairs quicker and at less cost than by any other method.

*Buy SMOOTH-ON in 7-oz., 1-lb., or larger containers from your supply house, or if necessary, from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men for over 49 years.*



**FREE**

**REPAIR HANDBOOK SHOWS HOW**

40 Pages, 170 diagrams, and simple concise instructions for practical repairs to plant equipment, pipe lines and structures. A necessity in every plant. Your copy sent FREE if you fill in and return the coupon.

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1-44

**Do it with SMOOTH-ON**
The Iron Repair Cement of 1000 Uses


lantic seaboard, in and around Buenos Aires province, while the waterpower sites are several hundred miles away in the Andes foothills. Of Argentina's present 700.000 kw of installed capacity, 542,000 kw are in Buenos Aires province. The republic has only 31,000 kw of hydroelectric power, nearly all of which is in the provinces of Mendoza, Cordova and Tucuman.

As part of a national public works program, Argentina plans to build a number of irrigation projects impounding large lakes in the northern and western region. Wherever possible this water will be used to produce power. although this is secondary to irrigation.

A number of South American countries have indicated their desire to have their electric power facilities controlled by their own nationals. They desire foreign equipment and technical assistance more than foreign capital in the development of their waterpower resources.

If they develop waterpower with their own capital and distribute the power to principal consumption centers at a reasonable cost, their economic positions will be materially strengthened by the extent to which foreign exchange requirements for purchase of imported fuel will be reduced, as well as by the advantages accruing from power itself.

There should be an opportunity for engineers and manufacturers in the United States to participate in these large programs of the South American republics on a mutually advantageous basis.

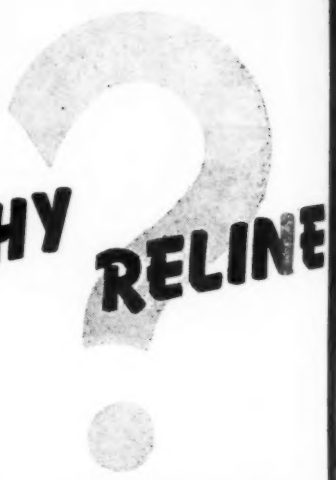
## High-Moisture Coals

(*Continued from page* 88)

500-cc flask, containing 100 grams of coal and 200 cc of xylene, to the condenser of the apparatus, Fig. 2, and heat flask until no more water comes over into the trap. Percent of water in the sample then equals the number of cc of water in the trap. measured at room temperature, with the proper correction for the water-xylene meniscus (usually plus 0.1 or 0.2 cc).

Btu and ash determinations are run according to standard procedures, care being taken to ash the coal slowly to prevent spattering.

**Volatile determination:** This follows procedures outlined in the Bureau of Mines R I 3168 "The Determination of Volatile Matter in Low-Temperature Cokes, Chars and Non-Coking Coals," using method 12. The preliminary heat-


**Keep Bricks New**
**with**

**BRICKSEAL**

**Highly-glazed—Vitrified Monolithic Coating**

Simply brush or spray Brickseal over your refractory lining, and start boiler operation at once. Furnace heat vitrifies Brickseal permanently into all pores, cracks and joints, binding the bricks with a highly-glazed, monolithic coating, impervious to slagging, clinkering, corrosive vapors, flame abrasion and air infiltration.

Sudden temperature changes cannot crack or loosen Brickseal because it remains semi-plastic until boiler cools. Brickseal costs only a fraction of a reline job, and assures long, efficient, trouble-free boiler operation. Write now for sample or Brickseal engineer.

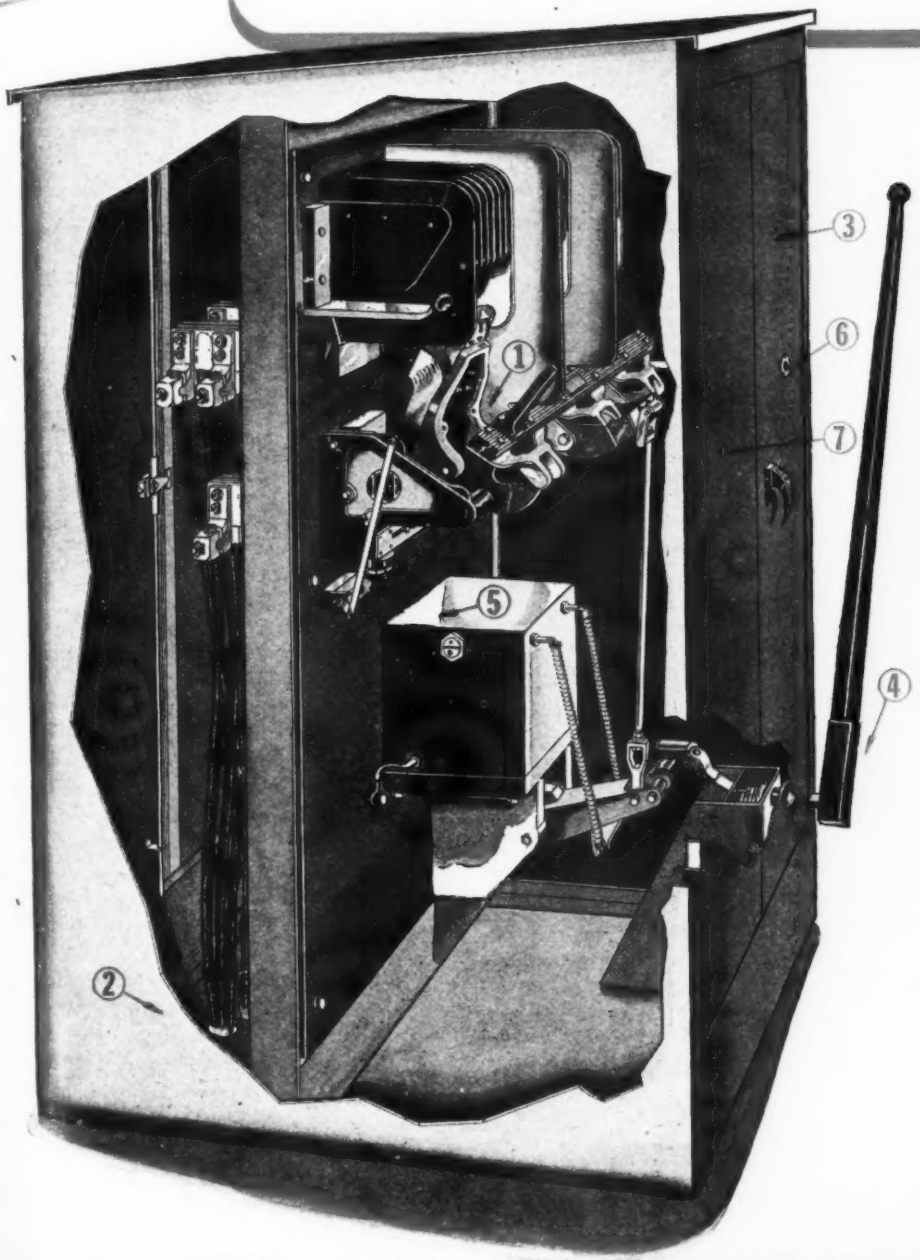
**BRICKSEAL**
**REFRACTORY CO.**
1029 CLINTON ST., HOBOKEN, N. J.

# Large I-T-E Circuit Breakers

## IN INDIVIDUAL METAL ENCLOSURES

**000 to 10,000 Amperes**
**Up to 600 Volts A-C**
**or 250 Volts D-C**

These large, enclosed I-T-E circuit breakers offer the same dependable service that thousands of U-Re-Lites, or medium-size enclosed breakers, have been giving for years. They are the time-tested type LG, mounted in individual steel cubicles for either indoor or outdoor service. They are easy to install and connect up, require very little maintenance.




1. The type LG trip free circuit breaker is fully enclosed and protected to give reliable performance.

2. Steel enclosure protects breaker against accidental damage and prevents men working nearby from touching live parts. The cables may enter at top, bottom or side. Outdoor enclosures are weatherproof, with a sloping roof and projecting eaves.

3. Hinged doors are easily opened for inspection without removing breaker from service. Three-point latches assure tight closure. Similar rear doors make the connection studs fully accessible.

4. Outdoor breakers use a removable, rotary, manual operating handle, as shown here. Indoor types may have either a rotary or spade handle.

5. Solenoid operating mechanism with a trip-free relay is provided for electrically operated breakers. Control power may be d-c or a-c.

6. Trip button is readily accessible without opening the doors. In outdoor types this button is covered with a flexible, weatherproof diaphragm.

7. Position indicator may be seen through a small window, showing whether breaker is open or closed.

I-T-E

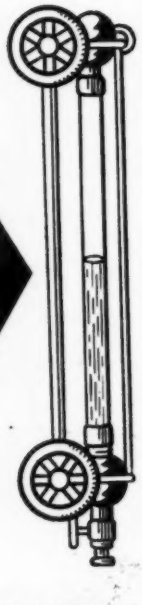
**AIR SWITCHGEAR**

IMMERSED IN AIR • ENCASED IN STEEL

*Representatives in Principal Cities*

**CIRCUIT BREAKER CO., PHILADELPHIA 30, PA.**

# MAINTAIN PROPER BOILER WATER LEVELS



## CONTINUOUSLY • AUTOMATICALLY • ACCURATELY

*under all* **LOAD CONDITIONS** *with*

## HENSZEY *Boiler Feed* REGULATORS!

The Henszey Regulator offers a dependable method of boiler water level control—helping to prevent the hazards of high water levels as well as low water levels. The unit is easily installed right in the feed line—no additional structural supports are needed. Once installed and set for operation no further attention is necessary—nothing to get out of order—nothing to rust.

Avoid the burned out tubes, cracked headers and even serious explosions that can result from low water levels. Avoid the damages that can be caused by water slugs being carried into the steam lines from high water levels.

Plan now for continuous, automatic boiler water level control . . . investigate Henszey Boiler Feed Regulators.

Made for pressures up to 600 lbs. and in sizes up to 4 inches.

**HENSZEY COMPANY**

**Dept. D1 Watertown, Wis.**

**HENSZEY**

**BOILER FEED REGULATORS**

**Continuous Blowdown • Distillation Systems • Heat Exchangers**

**Feed Water Meters • Flow Indicators • Proportioning Valves**


ing period consists of one minute at 590 C, two minutes at 640 C, two at 680 C, two at 745 C, one at 880 C. Final heating runs five minutes at 950 C.

Three major results follow use of above described methods instead of standard ones: (1) on coals of around 9500 Btu, the air-drying method gave results from 100 to 200 Btu lower, (2) on coals of around 25% moisture, the oven method gave results from 1.0 to 3.0% lower, and (3) on coals of about 30% volatile, the standard method gave results from 1.0 to 2.0% higher. The lowest volatile is considered the more nearly correct one.

The author claims no original work in connection with this analysis method; each individual step is probably in use in some coal laboratory. Their combined use makes the above procedure especially valuable in eliminating oxidation troubles in preparing the sample and in moisture determination. The preheating method for volatile-matter determination eliminates loss caused by sparking which is characteristic of high-moisture high-volatile coals.

## Gas Turbines

(*Continued from page* 93)

mum gas supply to the power turbine, which is also maintained at full gas temperature.

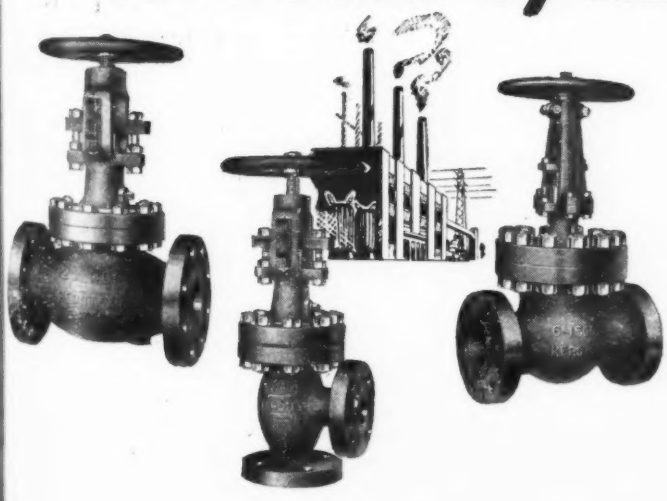
Marine propeller torque-speed characteristics show that while the propeller is still rotating ahead during reversing operations maximum torque requirements occur at about 40% of normal shaft speed, and the gas turbine can fulfill this condition with ample margin.

For ship maneuvering conditions it is possible to obtain rapid acceleration by employing a bypass valve (not shown in Fig. 2) ahead of the power turbine and operating the compressor at full speed. Any excess gas not required by the power turbine for the particular load under which it may be operating can be discharged to atmosphere through the bypass valve, and the sudden closing of the latter will produce maximum torque characteristics with full gas temperature on the power turbine.

In this respect the gas turbine will have essentially the same acceleration characteristics as a steam turbine installation. By momentary use of temperatures exceeding those for which the equipment was designed it is possible for the gas turbine to develop still greater torques for short periods. Operation of the bypass, while admittedly a low efficiency procedure, can be con-

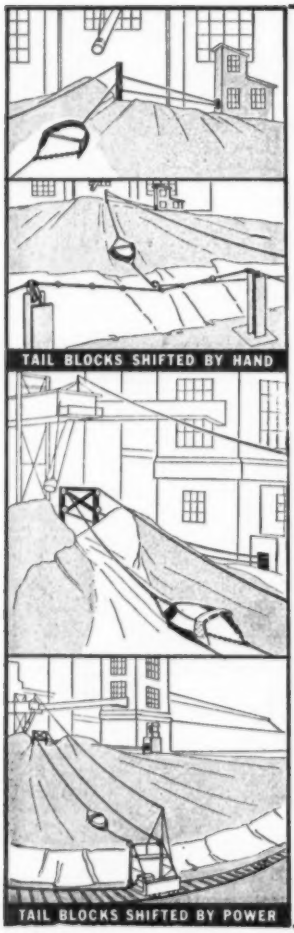
## LIFE OR DEATH MANEUVERS

# controlled by KEROTEST VALVES



The fever of action and movement when a convoy's under attack puts priceless value on control-valve *performance* . . . a grade of performance that is built-in unfailingly in every KEROTEST Marine Valve . . . through the "know-how" gained in years of experience . . . to be applied again for *your* benefit when the war is won.

KEROTEST




# How Sauerman Scrapers Simplify Coal Handling

The Sauerman Power Drag Scraper is a one-man machine that serves as a self-loading conveyor with large handling capacity and long reach, assuring full use of all ground space. The dominant feature of this machine is a cable-controlled, bottomless bucket that rides on the material it is to move. Pulled forward, the bucket loads and pulled backward it empties.

In storing, coal is dumped in front of a head post and is spread out from this initial pile by the bucket which stacks one layer of coal on top of another to any required height, forming a flat-top pile that is perfectly homogeneous and immune to spontaneous combustion. In reclaiming, the bucket is turned around and the coal hauled back.

Sauerman scraper installations in general are divided into two types: (a) With hand shifted tail-blocks; (b) With tail-blocks shifted by power, utilizing a self-propelled tail tower. The two types of installations are shown in the sketches at left.

## The Remarkable "Crescent" Bucket

Picture shows a Sauerman "Crescent" scraper bucket dumping its load of coal at outer rim of wide storage pile. In action, this streamline bucket encloses its load and virtually "floats" across the pile. The load is dumped automatically at any designated point and the bucket returns at high speed to get another load. Coming or going, this bucket rides lightly across the surface of the pile and accomplishes its work with a small expenditure of power.

WRITE FOR CATALOG

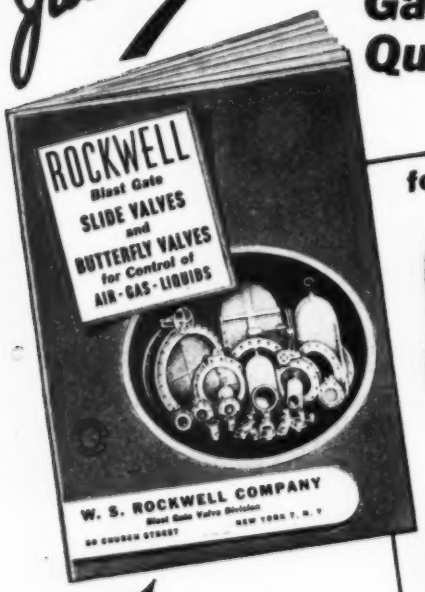
**SAUERMAN BROS., Inc.**

562 SOUTH CLINTON ST., CHICAGO 7, ILL.

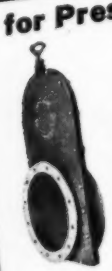


Just Out

# Learn How To Get Easier Control of Air Gas • Steam • Liquids Quick-Tight Shut-Off




for Pressures to 25 p. s. i.



SLIDE VALVES
1" to 20" Sizes
Hand, Lever Wheel or Chain Control

BUTTERFLY VALVES

1" to 48" Sizes
Manual Lever, Wheel or Chain Control or Any Automatic Control

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48 CHURCH ST. NEW YORK 7, N. Y.


doned in this instance because of the limited duration of the maneuvering period.

The bypass valve will also be of benefit during the starting of the compressor. When the bypass valve is open, atmospheric pressure exists at the exhaust of the high-pressure turbine and the power developed by it is greater than in normal operation.

The gas turbine also appears to be well adapted to heavy traction applications. A sectional drawing of a 5000-hp, 120-mph gas turbine locomotive resulting from an engineering study performed by Allis-Chalmers is shown in Fig. 4. The locomotive consists of a fore and aft power set, each set having a turbine driving a compressor and a second turbine, in parallel with the first, furnishing power to the drivers through a hydro-mechanical transmission. The transmission comprises a torque-converter and a hydraulic coupling, the former enabling high tractive effort to be obtained at starting and slow speeds, and the latter being used at high speeds. A combination transmission of this type has characteristics essentially equivalent to those of an electrical transmission.

The starting tractive effort for the locomotive is 70,000 pounds, equalling the limit of adhesion with a coefficient of static friction of 0.25. The locomotive is estimated to weigh about 112 lb. per hp, which compares very favorably with present day steam and diesel practice.

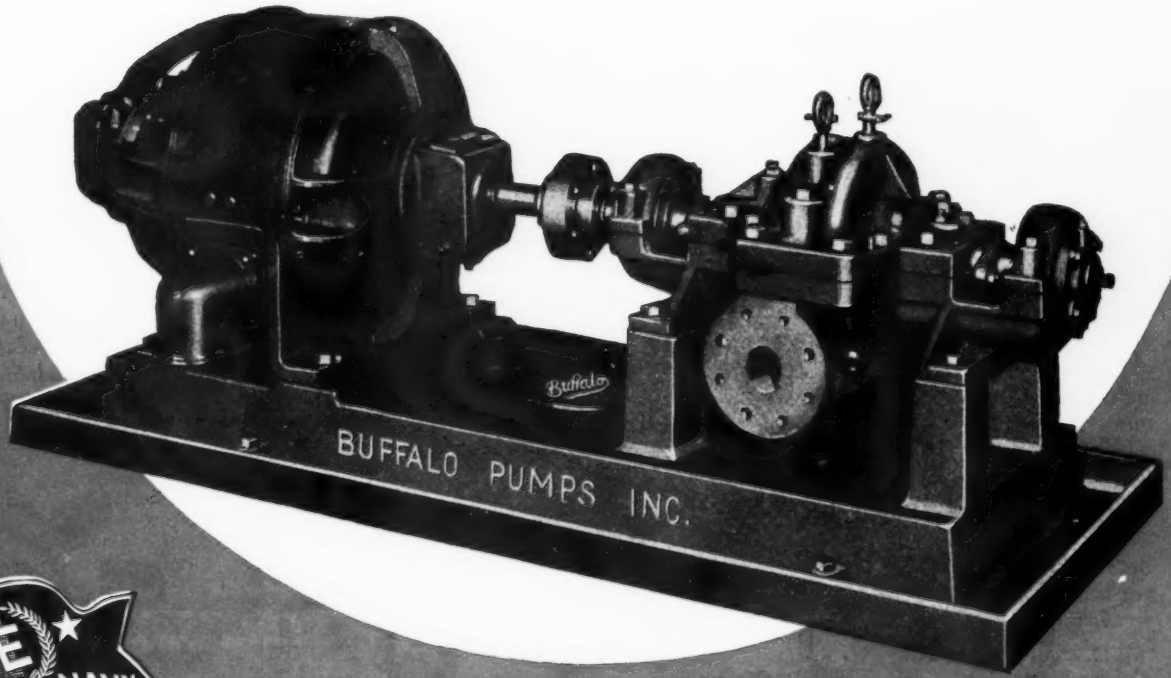
### *Stationary Unit*

While thermal efficiencies of 30% appear imminent with 1200 F inlet temperature, in order for the gas turbine to be of interest for central station use in all probability it will be necessary to use pulverized coal, and experiments along these lines are promising. The appreciable difference in price between coal and oil as well as the possible future scarcity of the latter are incentives for the acceleration of such a program. Because of the limited heat release of pulverized coal when compared with liquid fuels apparently its application will be confined to stationary land stations, where space and weight are of less significance than in mobile plants, at least until higher heat release apparatus can be developed.

In conclusion, it is desired to state that the gas turbine is not considered as the answer to all power problems as its limitations are well recognized. It is believed, however, that there are certain applications for which it is ideally suited in land, marine, heavy traction, and aeronautical fields, and it is toward such ends that its present development is being directed.

# WHEN THE TALK TURNS TO POST-WAR ~~PLANNING~~ *pumping*

Planning new power or processing installations for that post-war production program? "Buffalo" General Service Pumps will prove dependable "cogs" in your expanded operations. Check through their specifications detail by detail—and you'll see the reason. There you will find practical, time-tested design backed by skillful workmanship—yes, pumps with an inbuilt extra margin of stamina to deliver *more* service for *more* years. Specify "Buffalo" General Service Pumps to get the *most* per pump-dollar. Engineering data in Bulletins on request.




ARMY E NAVY

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438 Broadway Buffalo, N. Y.

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GENERAL SERVICE

PUMPS

# STICKLE EQUIPMENT

SPEEDING VICTORY

•

HELPING USERS

IN 7 WAYS

1
SAVES STEAM

2
INCREASES BOILER CAPACITY

3
IMPROVES OPERATING EFFICIENCY

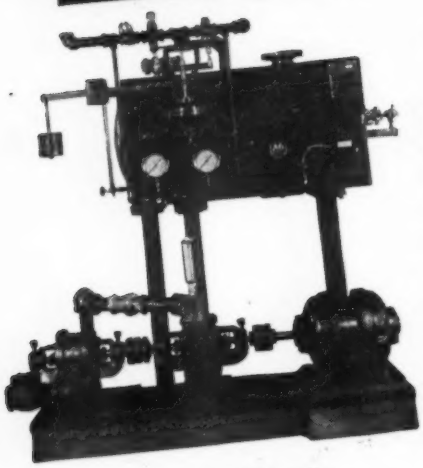
4
SAVES FUEL

5
RELIEVES TRANSPORTATION

6
SAVES MANPOWER

7
REDUCES MAINTENANCE

**Operating advantages that increase national power and multiply the production capacity of men and machines, so essential in days of emergency, have great significance for management in the period after victory.**



## THE STICKLE LINE

● Stickle Open Coil Feed Water Heaters, in sizes to meet needs of small plants and large industries, save fuel costs and reduce boiler maintenance. Illustrated and described in Bulletin No. 117. . . . Stickle Differential Drainage and Boiler Return System—a closed pumping system—puts condensate back into the boilers at a temperature only 15 to 20 degrees lower than steam at operating pressures, saving up to 20 per cent. on fuel consumption and increasing boiler capacity proportionately. For complete information, ask for Bulletin No. 50. Stickle Steam Traps—Open Float operating principle—devoid of complicated internal mechanism—reduce steam consumption in terms of operating results—permit equipment to function at maximum efficiency. Traps designed in series for various capacities and pressures. State application when asking for bulletin. . . . Stickle Regulating and Reducing Valves—single-seated and double-seated series—small to large sizes—in standard types—supply all demands for accuracy and dependability. Complete data in Bulletins Nos. 235 and 435.

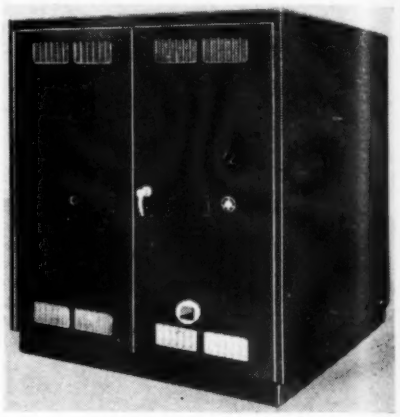
STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE, INDIANAPOLIS, INDIANA


## New Equipment

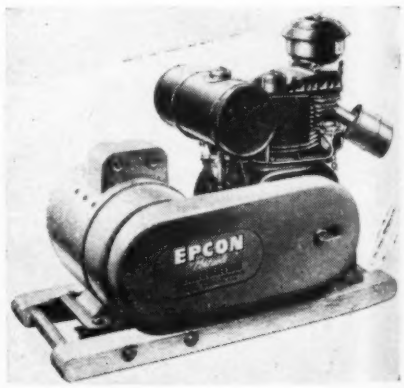
(*Continued from page* 130)

former, potentiometer which gradually raises test voltage, voltmeter to measure breakdown values, automatic circuit breaker and oil testing receptacle. *General Electric Co, Schenectady, N. Y.*



### Air Circuit Breakers

LG AIR CIRCUIT BREAKERS in individual metal inclosures are rated from 2000 to 10,000 amp, with interrupting ratings of 75,000 and 100,000 amp. Standard voltages are 600-v ac and 250-v dc. Operation may be either manual or electric. Inclosures supplied for indoor, as shown, or outdoor service. Circuit breaker may be opened or closed without opening inclosure. Front and rear doors provide access to breaker and connection studs. Connecting cables may enter inclosure at top, bottom or sides. *I-T-E Circuit Breaker Co, 19th & Hamilton St, Philadelphia 30, Pa.*



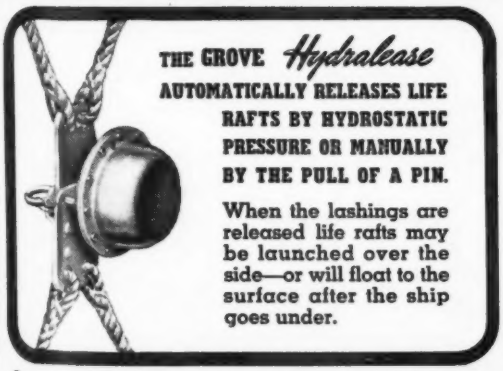

### Portable Generator

AIR-COOLED Epcon B-30 generator meets wartime needs for portable power and light, delivers 3000 w, 110-v ac, 60 cycle. Field ring is annealed cast steel. Cast-iron fittings secure both generator

# GROVE PRESSURE CONTROLS

## SAVE LIVES...

## ...ON FAST SINKING SHIPS



**THE GROVE *Hydralease* AUTOMATICALLY RELEASES LIFE RAFTS BY HYDROSTATIC PRESSURE OR MANUALLY BY THE PULL OF A PIN.**

When the lashings are released life rafts may be launched over the side—or will float to the surface after the ship goes under.

*Approved Equipment in accordance with U. S. Navy Bureau of Ships Ad Interim Specification 19R2(INT).*

Wars are fought with implements of destruction, but Victory is won by the lives that are saved. Besides fashioning the deadliest fighting instruments, American engineering genius has perfected the world's finest life saving equipment. Developed from experience in the field of Automatic Pressure Control, the Grove Hydralease, an automatic life saving device, now stands ready to rescue thousands of American boys from watery graves. On fast sinking ships this novel unit releases the lashings on life rafts and other buoyant equipment. It is actuated by hydrostatic pressure when the ship goes under. When time permits, it can be instantly released by simply pulling a pin. Other Grove products are likewise contributing to winning this war and will insure greater efficiencies during the peace to come.

# GROVE

GROVE
SIMPLICITY
ACCURACY
SAFETY

**GROVE REGULATOR COMPANY**

6547 GREEN STREET, OAKLAND (8), CALIFORNIA

*BRANCH OFFICES:* 5644 NAVIGATION BLVD., HOUSTON (11), TEXAS; 30 ROCKEFELLER PLAZA, NEW YORK CITY (20), NEW YORK

# New DEVELOPMENTS BY FREDERICK ADD NEW THRIFT and CONVENIENCE TO INDUSTRIAL STOKER OPERATION

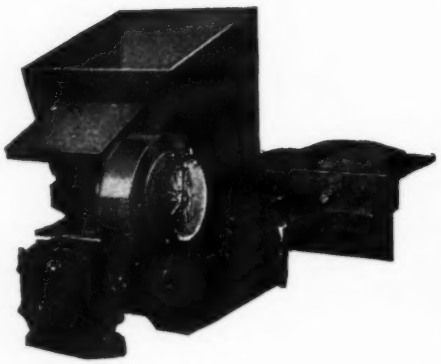
• FULL ACTIVE GRATE SURFACE . . . that's one new Frederick advantage! There's more grate area; no dead plates—whether furnished with or without side dumping grates.

• IMPROVED TUYERES are designed with air ports so arranged and proportioned as to insure thorough air distribution and maximum combustion efficiency.

• TUYERES ARE LOCKED IN PLACE so they cannot be raked up inadvertently.

• COMPLETELY INCLOSED WINDBOX simplifies and makes a neater installation; eliminates danger of efficiency loss through leaky brickwork.

• TWO CLEAN-OUT DOORS give easy access to both sides of the undergrate area to facilitate cleaning.



*. . . All these features, and many more, are Frederick innovations engineered to give you more for your stoker dollar than has been available ever before. A complete description of these features is in our new Stoker Bulletin. Ask for your free copy. You'll find it's interesting reading.*

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COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS - ASH STORAGE BINS

FOR V-DAY BUILDING

BREECHINGS
AIR DUCTS
UPTAKES
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For the Utmost in Efficiency and Long Life Specify—

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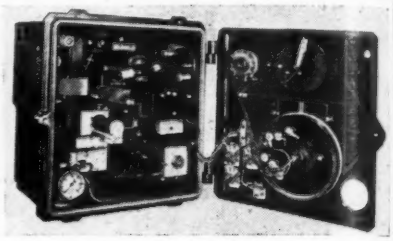
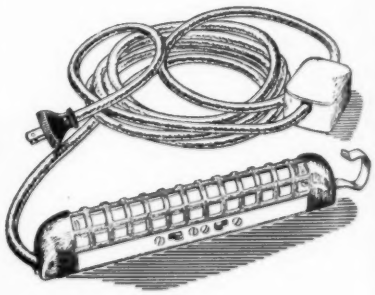
CONNERY CONSTRUCTION CO.
SECOND & LUZERNE STS. PHILADELPHIA


and engine to oak sled runners which serve as a strong but light base. End bells, instead of being solid and heavy, are of open design. Dust covers are light-weight steel spinnings. Pulleys made of cast-steel disks instead of solid metal. V-belt drive represents a weight saving over direct-drive models on which generator must be heavy and solid enough to be held in right position for direct driveshaft, according to maker. *Electrical Products Consolidated, Seattle, Wash.*



## Pneumatic Controller

UNIQUE FEATURES of Tag Celectray pneumatic-indicating controller include, according to manufacturer: (1) no motor or other continuously moving parts (2) continuous action (3) no measurable *dead zone* (4) highest sensitivity and adjustment to low sensitivity (5) no mechanical connection between galvanometer and pneumatic circuit (6) no *flapper* (7) simple load error adjustment (manual reset). *C J Tagliabue Mfg Co, 550 Park Ave, Brooklyn 5, N. Y.*



## Extension-Cord Lamp

FLUORESCENT lamp P-7 for close work and inspection in confined working areas; complete with 6-w white fluorescent lamp, ballast-operating equipment and 12-ft cord. Operates on 60-cycle ac only, 110 to 125 v. Total wattage, including lamps and auxiliary, is 8 w. *Sylvania Electric Products Inc, Ipswich, Mass.*

## Valvactor

VERNIER VALVACTOR is a micro-positioner for pneumatic motor valves. Continuing operating principles of older model, added ease and adjustment range, espe-

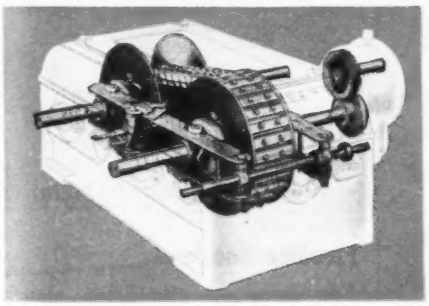
# REEVES *Reducer-Type* Transmission

## Stepless Speed Adjustability and Speed Reduction in One Compact Unit

Here is a new REEVES Variable Speed Control unit, which consists of the widely preferred REEVES Variable Speed Transmission with built-in, helical-type speed reducer.

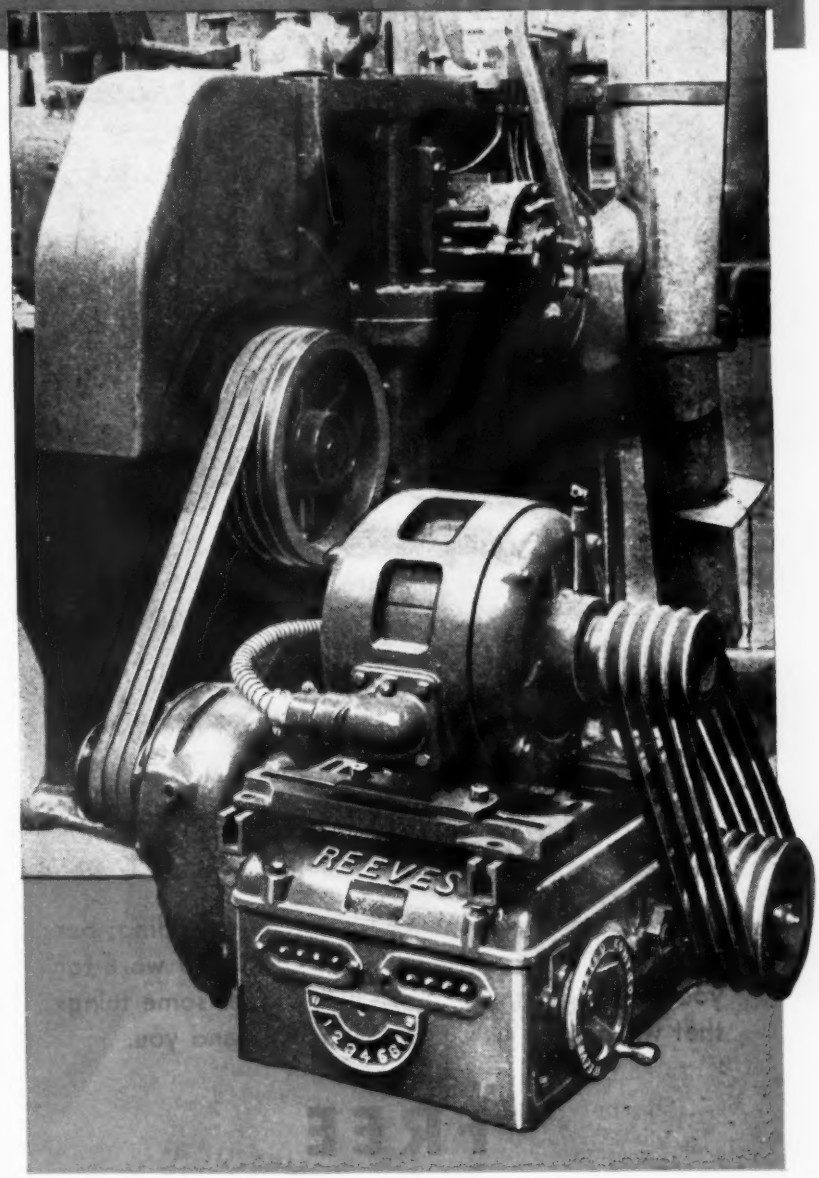
An outstanding advantage of this modern, highly efficient drive is that far less mounting space is needed to obtain the lower output speeds which formerly required the use of auxiliary speed reducing equipment.

The REEVES Reducer-Type Transmission is built in two completely enclosed designs —horizontal and vertical. Either of these designs is available in many different horse power capacities and ranges of speed variation, and may be mounted in almost any position on or near the driven machine. Either design may be equipped for individual motor drive by use of the REEVES adjustable motor base, as shown in the installation at right. Any available motor can be accommodated. Speed shifting controls may be handwheel, electric remote or completely automatic. Send for catalog PTR-432, giving complete information.



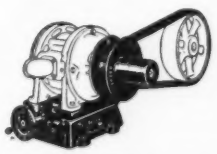
"X-ray" view shows how pinion of reduction gears is mounted on variable speed shaft of Transmission, this shaft serving as input shaft for reducer unit.

**REEVES PULLEY COMPANY**
**COLUMBUS • INDIANA**

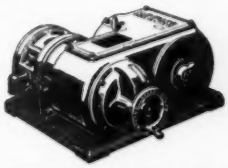



### THE 3 BASIC UNITS IN THE REEVES LINE

**VARIABLE SPEED TRANSMISSION** for providing infinite, accurate speed flexibility over wide range, 2:1-16:1. To 87 h.p.



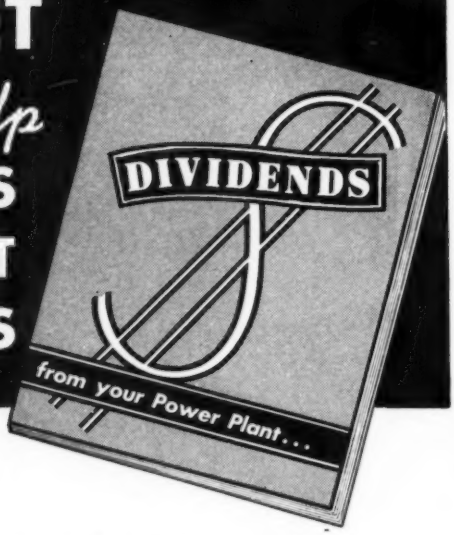
**VARI-SPEED MOTOR PULLEY** converts any standard constant speed motor to a variable speed drive. In sizes to 15 h.p.



**MOTODRIVE** combines motor, speed varying mechanism and reduction gears in a single unit. In sizes to 10 h.p. capacities.

# REEVES *Accurate Variable* SPEED CONTROL

# A NEW KIND OF BOOKLET *that will help* ENGINEERS *and* PLANT MANAGERS




This is not the usual sales bulletin that extols the advantages of some particular make of power-plant product. The only sales message it contains is one that works for the operating engineer.

It tells the non-technical executive what he ought to know about steam generation and boiler efficiency. It tells him how to work with the engineer. Its chapter on labor costs may jolt some executives—there are some new ideas in it for them.

This is a booklet which you may enjoy reading; but what is more important, it can be put to work for you. It will tell your company manager some things that will benefit him, your company—and you.

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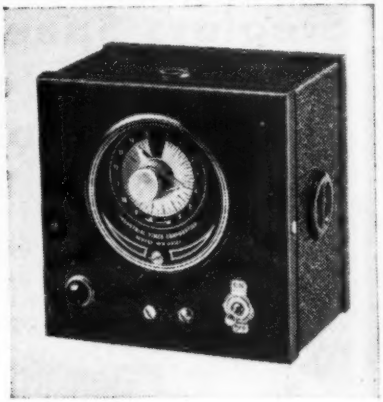
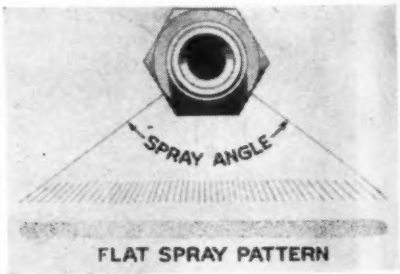
cially for duplexing and sequencing, and new snap action, for relay service or step sequencing of valves or damper motors, are provided by convenient zero and range adjustments. Unit retains advantage of relay action. Flexure bearings eliminate effects of mechanical vibration, without sensitivity loss. Unit in a heavier metal case than former model. *Foxboro Co, Foxboro, Mass.*



### Signaling Timer

SERIES S, 5x5x3½-in. deep, inclosed in black metal case, is attachable to any wall, panel or standard switch box. Operates on ac; 115 to 230 v; 25, 50 or 60 cycles. Slow-speed self-starting synchronous motor. Timer, for automatic closing or opening of circuit at end of elapsed time, operates additional buzzers, bells or lights at remote locations. *Industrial Timer Corp, 117 Edison Pl, Newark, N. J.*




### Flooding Noozle

FOR SPRAYING eliminator plates and similar applications, nozzle has wide flat spray. Curved areas produce spray in most efficient manner, according to manufacturer. Wide-angle spray may also be obtained. *Spraying Systems Co, Chicago, Ill.*

### Rotary Pump

UNIT OPERATES on the *bucket design* (swinging-vane principle). It has a capacity of 50 gpm at a discharge pressure of 20 psi and is direct connected by a flexible coupling to a 3-hp 870-rpm motor. Bearings are internal anti-fric-

# LIGHT
## CLOSE TO THE WORK

Better lighting is a "must" in industry today — a means of attaining smoother, faster production after every other production aid has added its push.

BullDog Universal Trol-E-Duct makes possible that better lighting — brings the light right to the work — makes it easy to move or rearrange lights, or entire lighting systems, at any time and without interfering with production.

UNIVERSAL Trol-E-Duct

# POWER
## CLOSE TO THE TOOL

Don't waste valuable production time while workers look for power outlets for portable tools. Don't risk accidents due to tripping over long cords, or shorting tangled cables.

Bring the power right to the job with BullDog Industrial Trol-E-Duct—the system that not only furnishes mobile power, but also support, for portable tools.

INDUSTRIAL Trol-E-Duct

**BULLDOG**
**ELECTRIC PRODUCTS CO.**

Box 177, R. Pk. Annex
Detroit 32, Michigan

BullDog Electric Products of Canada, Ltd., Toronto, Ontario

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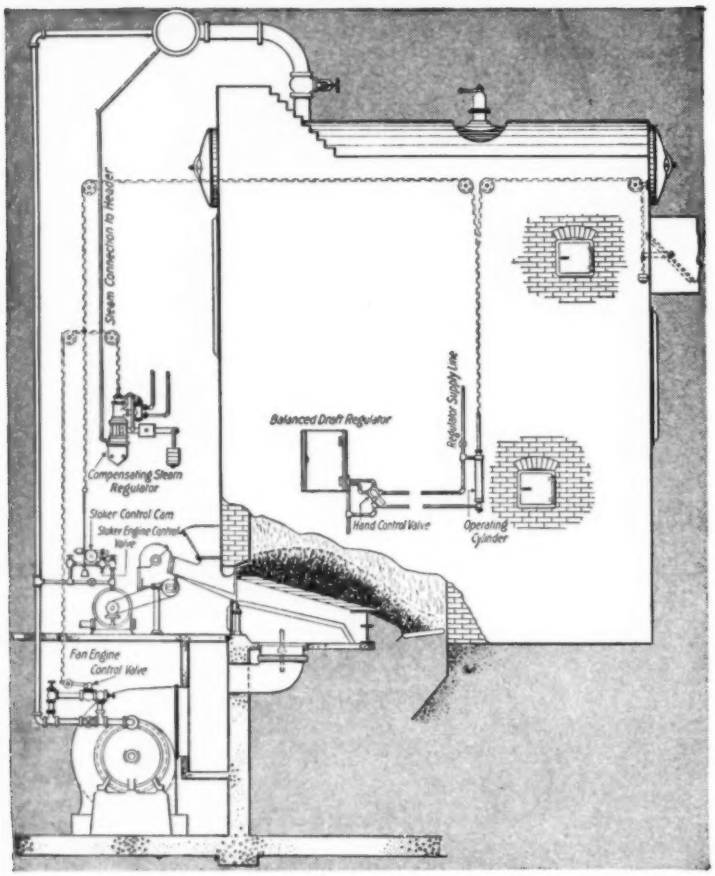
MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.

You SAVE What You SPEND for WAR BONDS

BullDog Universal Trol-E-Duct *for light,* and Industrial Trol-E-Duct *for mobile power,* are both furnished in standardized, interchangeable sections. Both are completely salvable, suitable for quick removal to a new department or to a new plant.

Ask for complete illustrated bulletins Nos. 425 and 407, describing these two time and money saving, production speeding, BullDog systems.

# Enco Balanced Draft




## A PRACTICAL SYSTEM THAT AUTOMATICALLY CONTROLS

### . . . FURNACE PRESSURE, STEAM PRESSURE, FANS AND STOKERS

**You can get all the advantages of balanced draft with the Enco system which conforms to accepted practices of combustion control and yet is simple and easy to install and maintain.**

**It is adaptable to all methods of coal firing . . . stokers of the underfeed, overfeed, spreader or traveling grate types, as well as hand-firing.**

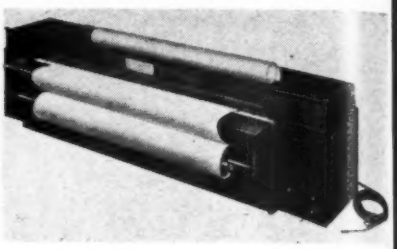
**The apparatus is so free of complications and delicate mechanisms that it can be installed by your own maintenance crew and kept in operation with the greatest ease.**

**It may be either hydraulically or pneumatically actuated.**

**Ask for bulletin B.D. 43 on "Combustion Control" and get the facts on this practical, low cost system that has been in use for over 25 years on more than 1000 boilers.**

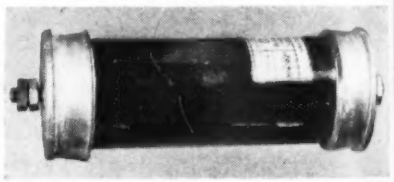
**THE ENGINEER COMPANY**
**75 WEST STREET (Enco) NEW YORK, N.Y.**


tion type; a split gland is used for ease in repacking. To conserve space, motor is supported by a welded-steel-plate bracket bolted to bulkhead. Pump mounts vertically on bracket base, permitting free access for lubrication and adjustments. Marine pump has many applications in industrial and processing plants. *Blackmer Pump Co, Grand Rapids 9, Mich.*



## Speedy Printers

CONTINUOUS table printers B-1 and B-2 produce clear, sharp blueprints or direct-process black-and-white prints up to 44-in. width in any length, at a speed up to 42 in. per min, according to manufacturer. Mercury-vapor-tube lamps, mounted horizontally, give uniform light intensity. Ball bearing equipped, variable-speed drive provides wide speed range. No lubrication. *Peck and Harvey, 4327 Addison St, Chicago, Ill.*

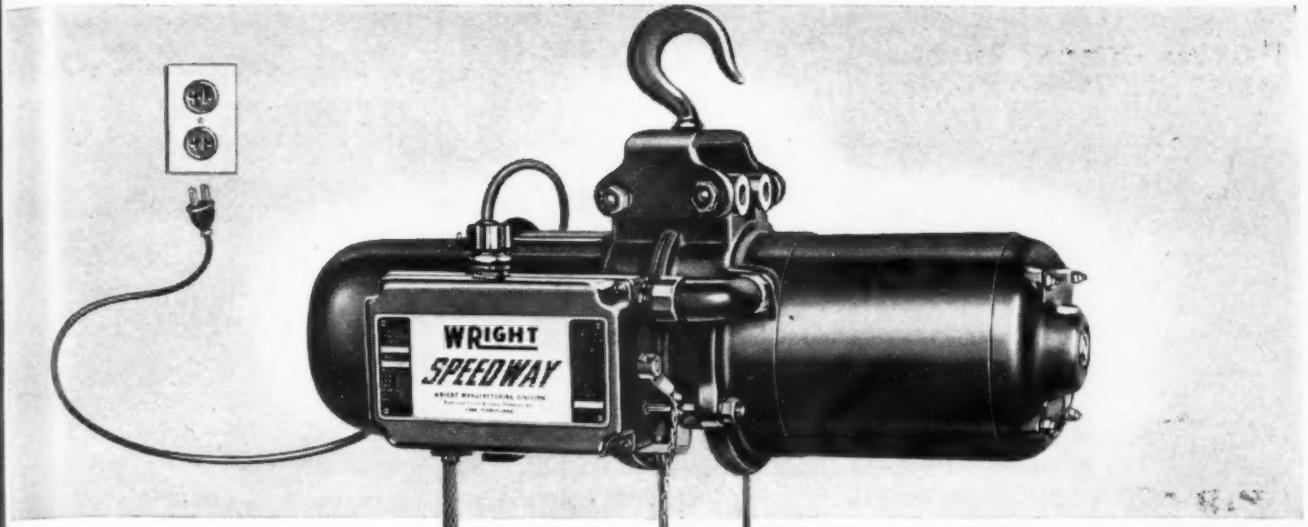


## Capacitors

SOLDER-SEALED porcelain-clad FPC interteen capacitors for high-voltage dc applications where space is limited. From 7500-v up to and including 200,000-v class, capacitor elements are hermetically sealed in a tubular, wet-process porcelain body with solder-sealed end closures acting as capacitor terminal by connecting element leads at opposite ends, utilizing porcelain tube as insulation. Larger models are furnished with or without cast mounting flanges. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

## Synthetic Shellac

ZINLAC SYNTHETIC SHELLAC, maker claims, duplicates natural product, and even surpasses it in some properties, such as adhesion to metal as well as wood and subsequent resistance to water. *William Zinsser & Co, 516 W 59th St, New York, N. Y.*




# A MASTER-PIECE FOR increased production

*In Business for Your Safety*

● The period of hurry—the need for faster production—won't be over with the war. Post-war work will impose its demands too. Get an Improved **WRIGHT** *SPEEDWAY* Electric Hoist as soon as possible for both now and tomorrow. Because it speeds up work and makes jobs easier, **WRIGHT'S** *SPEEDWAY* saves labor time, cuts handling costs—quickly pays for itself.

Women workers in war plants especially appreciate the push-button ease with which the **WRIGHT** *SPEEDWAY* is operated. The *SPEEDWAY* helps them maintain their morning vigor throughout the afternoon.

The *SPEEDWAY* Electric is a sturdy, light weight, cable hoist, designed for fast lifting on assembly floors and for general use. Designed with spur gear construction, magnetic control, and mechanical features found only in the more expensive production-type hoists. Yet it is priced economically low.

Talk to your **WRIGHT** distributor about *SPEEDWAY*'s advantages. He is listed in your classified telephone directory.

**WRIGHT MANUFACTURING DIVISION**
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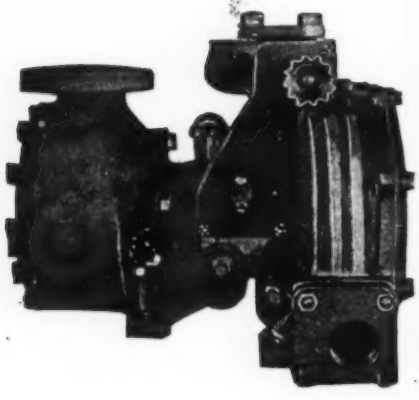
ARMY NAVY
FLYING OVER THE WRIGHT HOIST PLANT

# WRIGHT *SPEEDWAY* HOISTS

## The COFFIN-Steam Turbine CENTRIFUGAL PUMPS

For Boiler Feed and general high pressure service.

*See previous issue for details*



**THE J. S. COFFIN, JR., Co.**

**ENGLEWOOD, N. J.**

## CAN'T SHAKE LOOSE!

Pat'd. & Pat's. Pend.

**UNSHAKO**

Reg. U. S. Pat. Off.

**SELF-LOCKING NUT**

A built-in, self-energizing locking ring which operates on brake band principle keeps the "Unshako" securely in place no matter how severe the vibration, yet it can be readily removed with a wrench and used over again as often as desired. Write for details.

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## Here's Why...

Because it gives you specific data and recommendations that will help you solve *your* particular problem of boiler water treatment and control. It contains both a simple and technical explanation of pH control, a full discussion of boiler water with reference to phosphates, silica, steam condensate, etc., and descriptions of all Taylor outfits for the determination of pH, chlorine, phosphates, silica, ammonia, etc.

Many engineers, chemists, and operators keep this handbook on their desks for reference purposes since it contains information which cannot be found elsewhere except by reference to many different books and periodicals.

**WRITE FOR THIS BOOK TODAY—IT'S FREE**

*It will be a valuable addition to your reference library.*

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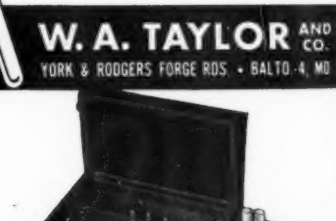
YORK & RODGERS FORGE RDS. • BALTO-4, MD



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***Boiler Water Comparator***

With it you can check the pH and/or phosphate content of your boiler water in a matter of only a few minutes. Help eliminate scale and periodic shutdowns . . . helps increase boiler efficiency . . . helps reduce fue bills . . . adds life to boilers.

Ease to use, slides and base molded of durable plastic. Absolutely accurate always because all Taylor Liquid Color Standards CARRY AN UNLIMITED GUARANTEE AGAINST FADING.

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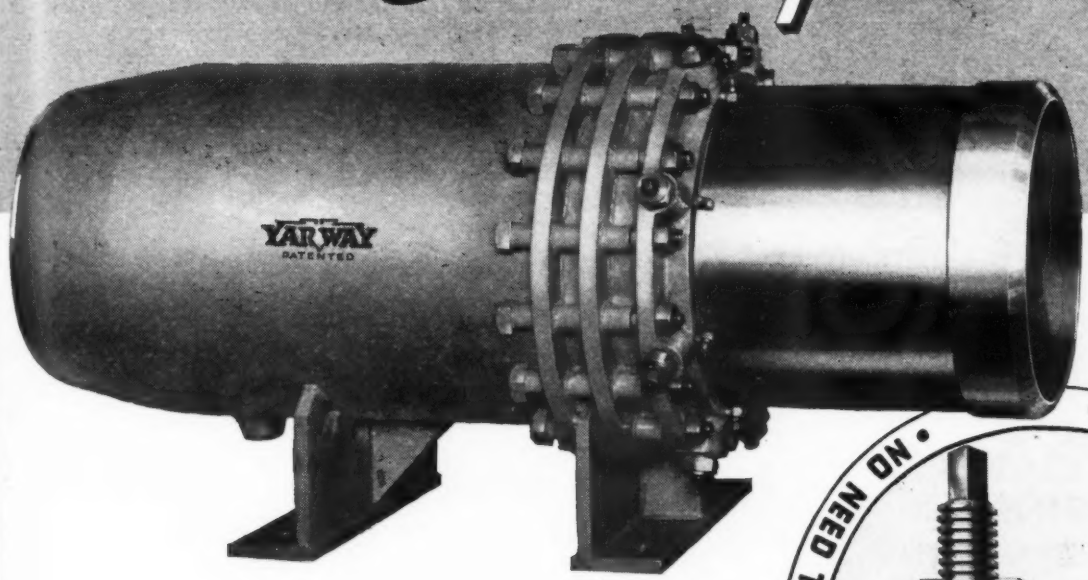

Years of experience with thousands of Yarway Gun-Pakt Expansion Joints have established the Yarway as the preference of leading industrials, utilities, institutions and government departments.

For they all have learned that this joint which is packed under full steam pressure and never needs to be unpacked—eliminates repacking shut-downs, saves a tremendous amount of time, trouble, money and hard labor under gruelling temperature conditions, normally required to keep slip-joints tight.

Why don't you investigate the Yarway Gun-Pakt Joint—called "the greatest expansion joint improvement of modern times."

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**YARNALL-WARING COMPANY**
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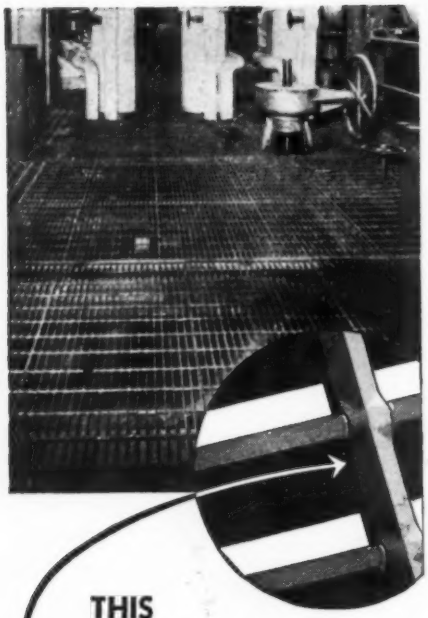
The Yarway Gun-Pakt Expansion Joint is the ONLY slip Joint which is packed without unpacking. By a twist of a wrench, a special Yarway semi-plastic packing is forced into the stuffing box by means of integral pressure guns while the joint is under *full steam pressure*. The old packing, rejuvenated by the new, need not be removed.

**YARWAY GUN-PAKT EXPANSION JOINT**



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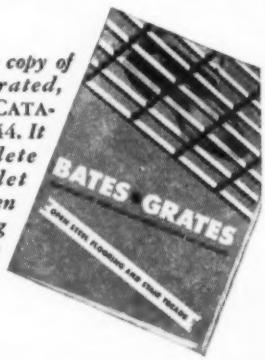
SCRAPER TREAD OF
**BATES-GRATES**
OPEN STEEL FLOORING
GIVES THE
**COMBINATION OF SAFETY AND CLEANLINESS**
YOU WANT IN OPEN STEEL FLOORING

This extra cleanliness and safety come with the use of welding technique that, for years, has been recognized as the correct method to follow—a simple fillet weld.

There is no burning and no overflow of surplus metal around the fillet into which is press-welded Bates Hex Bar Stock. You get top strength and rigidity in steel flooring that permits the maximum passage of air and light.

*Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.*

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JOLIET • ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

# *Design that provides—*

★ **A longer steam ring with greater nozzle area**

★ **Larger steam inlet size**

★ **Larger exhaust opening**

★ **Additional hand valves and improved efficiency**

THE type "UV" parallels the design of the type "U" single stage turbine. It has the same unique and patented arrangement of the casing which is split horizontally well above the shaft centerline.

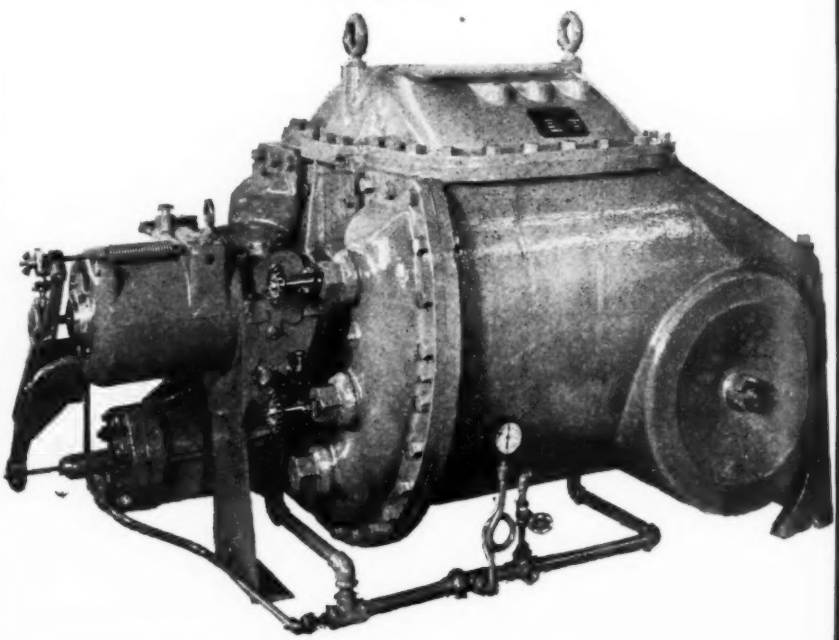
Picture shows the unit equipped with mechanical shaft type main speed governor and hand speed changer. The standard center lines exhaust end support and flexible steam end support are also shown.

# MURRAY

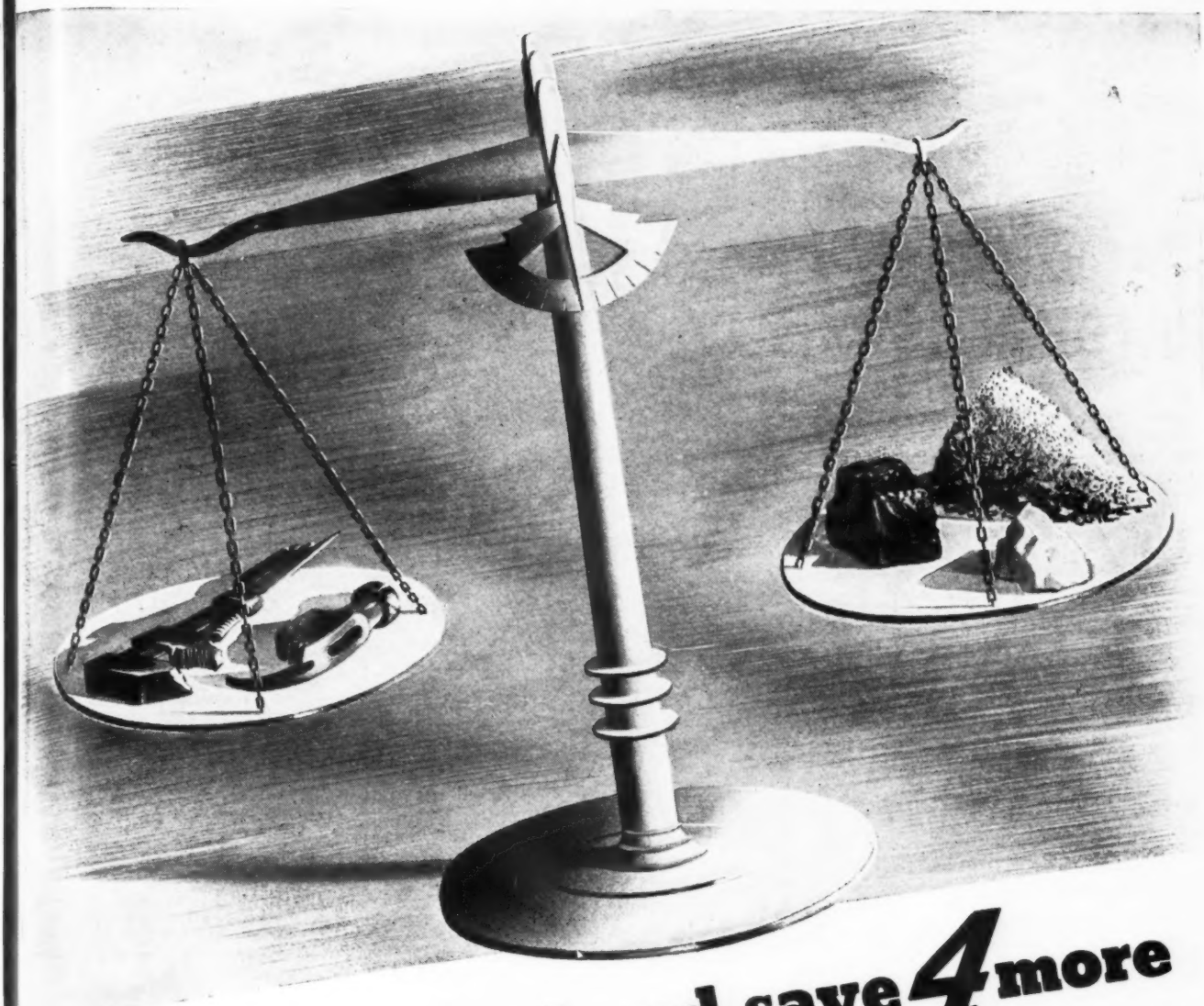
## *Type UV Multi-Stage*

## MECHANICAL DRIVE TURBINE

Can, if desired, be provided with oil relay governor either of the constant or variable speed type as well as extraction or extraction mixed pressure gear.



**MURRAY**
**IRON WORKS COMPANY**
INCORPORATED 1870
BURLINGTON IOWA



# Scrap a pound and save 4 more

EACH pound of scrap used in making war steel replaces a pound of pig iron.

To make one pound of iron requires nearly four pounds of ore, coal and limestone.

So when you turn in a pound of scrap you also conserve four pounds of vital raw materials. Translate this saving into terms of the 6,000,000 tons of steel scrap that the industry needs today. It is the equivalent of:

12,000,000 tons, or 240,000 carloads of iron ore,

7,200,000 tons, or 144,000 carloads of coal,

3,000,000 tons, or 60,000 carloads of limestone.

Think also of saving the millions of man hours of labor involved in mining, transporting and processing these 444,000 carloads of raw materials — enough to form a solid train stretching from Boston to San Francisco.

The more dormant scrap YOU salvage, the greater the amount of America's materials, machines and manpower is released for the all-important task of winning the war now.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

THROW YOUR SCRAP INTO THE FIGHT — YOUNGSTOWN

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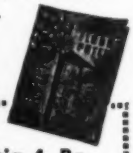
*Youngstown, Ohio*

25-43E

# PATCH FLOORS

## . . . while Traffic Rolls

Here's a new, fast way to patch broken concrete without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.



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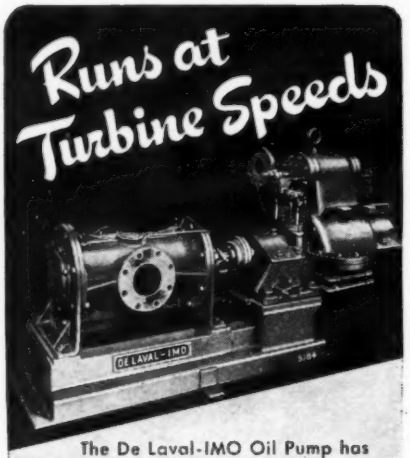
**FLEXROCK Co.**
**3677 Filbert St., Philadelphia 4, Pa.**

Please send me complete INSTANT-USE information . . . details of FREE TRIAL OFFER—no obligation.

Name .....
Company .....
Address .....

# Runs at Turbine Speeds




The De Laval-IMO Oil Pump has only 3 moving parts, which are in perfect rotational balance, and no gears, valves or separate bearings. It can be coupled directly to standard speed motors and turbines to deliver any grade of oil in any-volume against any pressure. The turbine-driven lube oil pump here shown is one of five in service on the World's largest ore carriers.

*Ask for Publication I-107.*

**IMO PUMP DIVISION**
of the De Laval Steam Turbine Company
Trenton, New Jersey

# "Ring of Distinction"

# Install FRANCE Metal Packing for "Round-the-Clock" PRODUCTION

The renewal of ordinary packing every few weeks or months increases horsepower and production costs.
Minimum friction is encountered with France Metal "Ring of Distinction" Packing. No undue force can be exerted on rods or stems by tightening the stuffing box stud nuts. The rings are free to float in the case that retains them and are held to the rod or stem with a garter spring having minimum tension.
The result is tight "full-floating" trouble-free performance for years. Prompt delivery assured.

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44-page Catalog of useful and valuable information. Write for your free copy of Catalog M-7, with facts on

- Packing Designs for Any Service
- Installation Procedure
- Methods of Lubrication
- Pressures and Temperatures
- Oil Return and Stripping Rings
- Handy Reference Tables

Request France Engineers to analyze your packing requirements. There is a representative close at hand.

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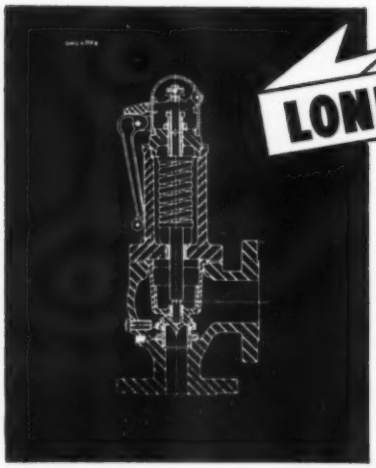
**Tacony, Philadelphia 35, Penna.**

*Original* FRANCE METAL PACKING



# LONERGAN MODEL "WTN-EL"

## THIS HIGH CAPACITY STEEL SAFETY VALVE IS PREFERRED EQUIPMENT IN MANY PLANTS

**Because . . .** It achieves efficiency with a *simple mechanism, good design.* The "WTN-EL" is top-guided . . . no restriction below the seat. With the largest practicable seat diameter for a given inlet size, the "WTN-EL" provides *extra safety* and *reserve capacity* at over-pressures. And, because the disc is shielded by the guide and is out of the path of flow, operation of the valve tends to be independent of back pressure. Working parts are of symmetrical design, compensating for both mechanical and thermal distortion. A single blow-down control provides easy adjustment.

Clean, positive action—long life—and economy of maintenance have won a host of friends for the "WTN-EL". Investigate this excellent valve the next time you need safety valves for new construction or replacements. Write for full data.

**Lonergan**
SAFETY VALVES, RELIEF VALVES, PRESSURE GAUGES, SPECIALTIES

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2ND AND RACE STREETS
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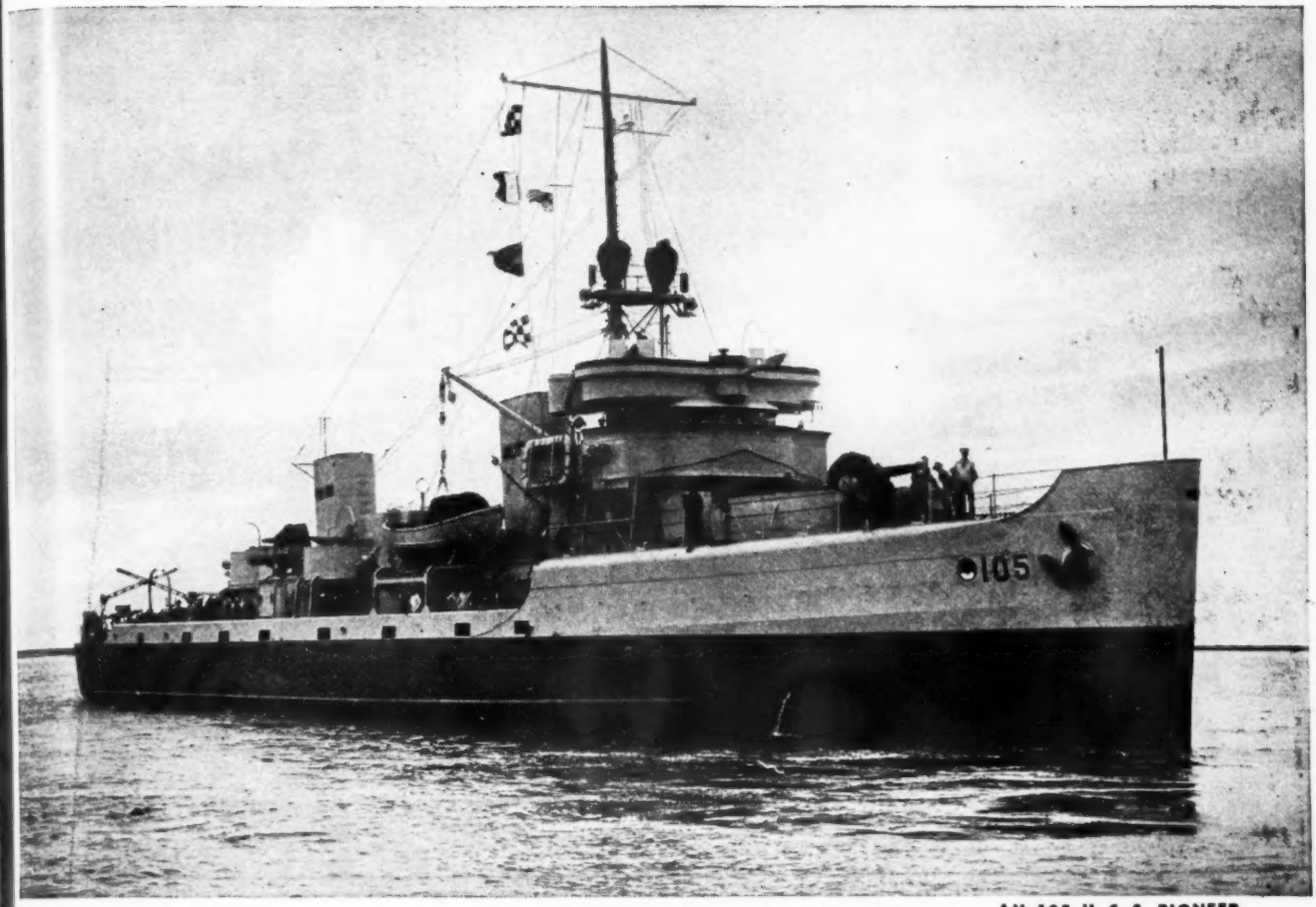


AM-105 U. S. S. PIONEER

# She Has Good Stuff in Her

She has to have. The U.S.S. Pioneer is one of our Navy's mine sweepers. Cruising around in quest of enemy mines keeps a sailor on his toes. Naturally, he feels confident when he knows he can rely on his ship. We're proud to say that the U. S. S. Pioneer is propelled by Diesel engines—made by the same Busch-Sulzer skilled workmen who are turning out precise ammunition hoists for the Navy's 5″/38 caliber guns . . . and engines for other naval and army craft, as well as engines for the U. S. Maritime Commission. Until this war program is completed, we can accept orders of high priority only for engines from 450 to 3600 horsepower.

**BUSCH-SULZER BROS.—DIESEL ENGINE COMPANY**
ST. LOUIS

**AMERICA'S OLDEST BUILDER OF DIESEL ENGINES**

**BUSCH-SULZER**
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ADAMANT
FIRE BRICK CEMENT

**Try this method of keeping down furnace maintenance costs . . .**

Lay-up linings with Adamant . . . its higher bonding strength (see below) protects the structure at the joints where failure usually begins. Result . . . linings last longer . . . production is maintained . . . repair costs and replacement materials saved.

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*Stronger by Test*

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs. at 2600° F. Adamant has a P.C.E. of 3000° F. plus. For more details, write

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**HANDBOOK**

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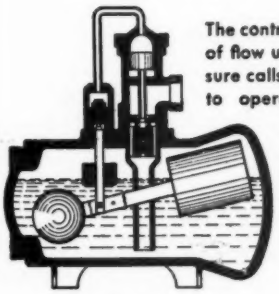
USE EVERY ISSUE

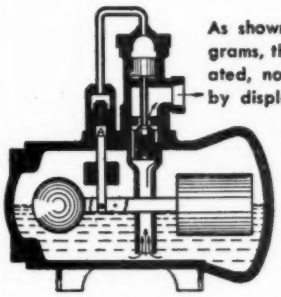


# How to Handle Condensate Drainage at High Pressures

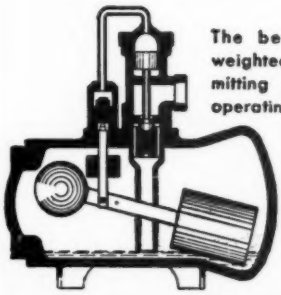


The control of a high rate of flow under high pressure calls for great force to operate the valve.

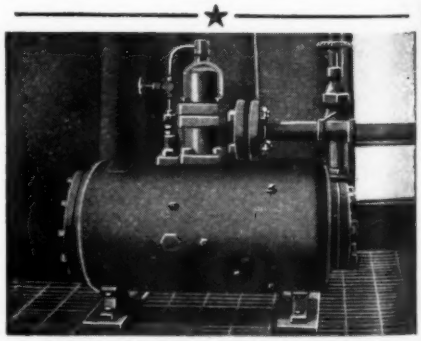
In the Cochrane Discharger this force is provided by a piston actuated by a pilot valve.



As shown in these diagrams, this pilot is operated, not by floats but by displacement bodies of different densities at either end of a beam which tilts with the rise and fall of the water level.



The beam opens the weighted pilot valve admitting steam to main operating valve which instantly opens main discharge valve to full opening, avoiding wire drawing or chatter.



*Publication 2935 gives complete data.*

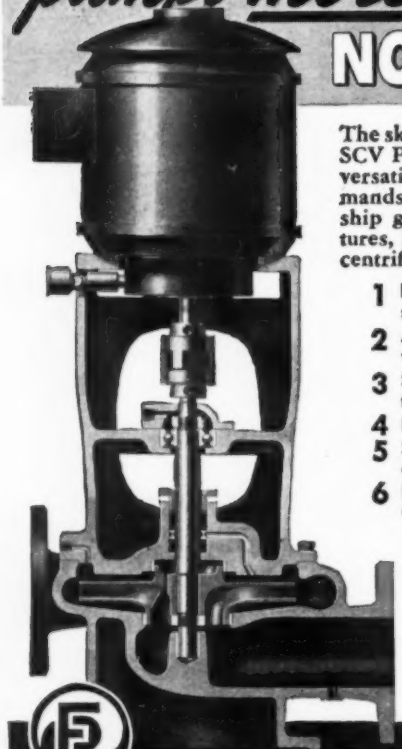
**COCHRANE CORPORATION**
3106 N. 17th St., Philadelphia, Pa.

**COCHRANE**
**STEAM SPECIALTIES**



*pumps more at less cost*

**NOW and for Post-war**



The skillfully engineered, compact design of this SCV Pump provides greater capacity, efficiency, versatility—to help meet today's increased demands. Its perfect balance and precise workmanship give it extra long life. The combined features, listed below, make it your first choice in centrifugal equipment.

1. **HIGH MOTOR MOUNTING—above floor splash and dirt.**
2. **ACCESSIBILITY—complete rotor removable without breaking pipe connections.**
3. **SMOOTH OPERATION—impeller spins between two bearings.**
4. **FLEXIBLE COUPLING—accessible stuffing box.**
5. **STANDARD MOTOR—avoids prolonged shutdown as any stock motor is usable.**
6. **HANDLES ALL CLEAR LIQUIDS—10 to 500 GPM. Heads up to 225 ft.**

Act now to cut operating costs and improve post-war plant efficiency. Economy's Engineering Service will gladly help you in the selection of efficient pump equipment, without obligation. Write for catalog D2-1042 and Economy's new Pump Data Book, free to Plant Engineers and Executives.

**ECONOMY PUMPS, Inc.**
HAMILTON, OHIO, U.S.A.

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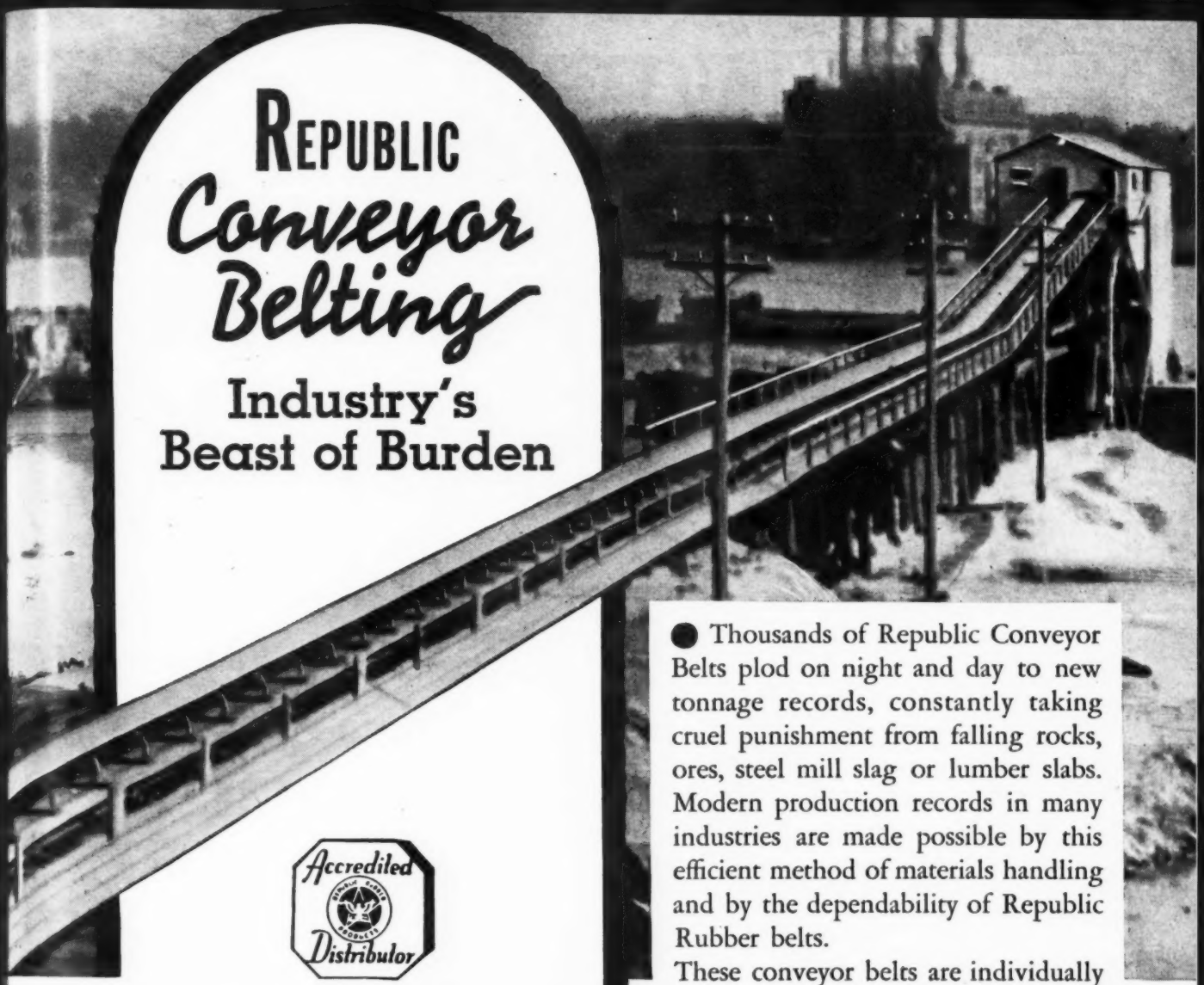
## Industry's Beast of Burden



● Thousands of Republic Conveyor Belts plod on night and day to new tonnage records, constantly taking cruel punishment from falling rocks, ores, steel mill slag or lumber slabs. Modern production records in many industries are made possible by this efficient method of materials handling and by the dependability of Republic Rubber belts.

These conveyor belts are individually engineered for the job, and are built to absorb shocks and heavy loads on long or short hauls. Your Republic Distributor is carefully chosen and through close factory cooperation is qualified to consult with you on proposed installations.

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## Make Your Overhead Valves SAFE And Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

**BABBITT STEAM SPECIALTY CO.**
New Bedford, Mass.

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### GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

**HERCULES FLOAT WORKS**
200 Franklin St.
SPRINGFIELD, MASS.

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2. Make equipment last.
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This chart has been issued as the third in a series of technical papers on Gaskets compiled by the Research Laboratory of the Goetze Gasket and Packing Company, Inc., oldest and largest manufacturers of industrial gaskets in America.

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**GOETZE GASKET & PACKING CO., Inc.**
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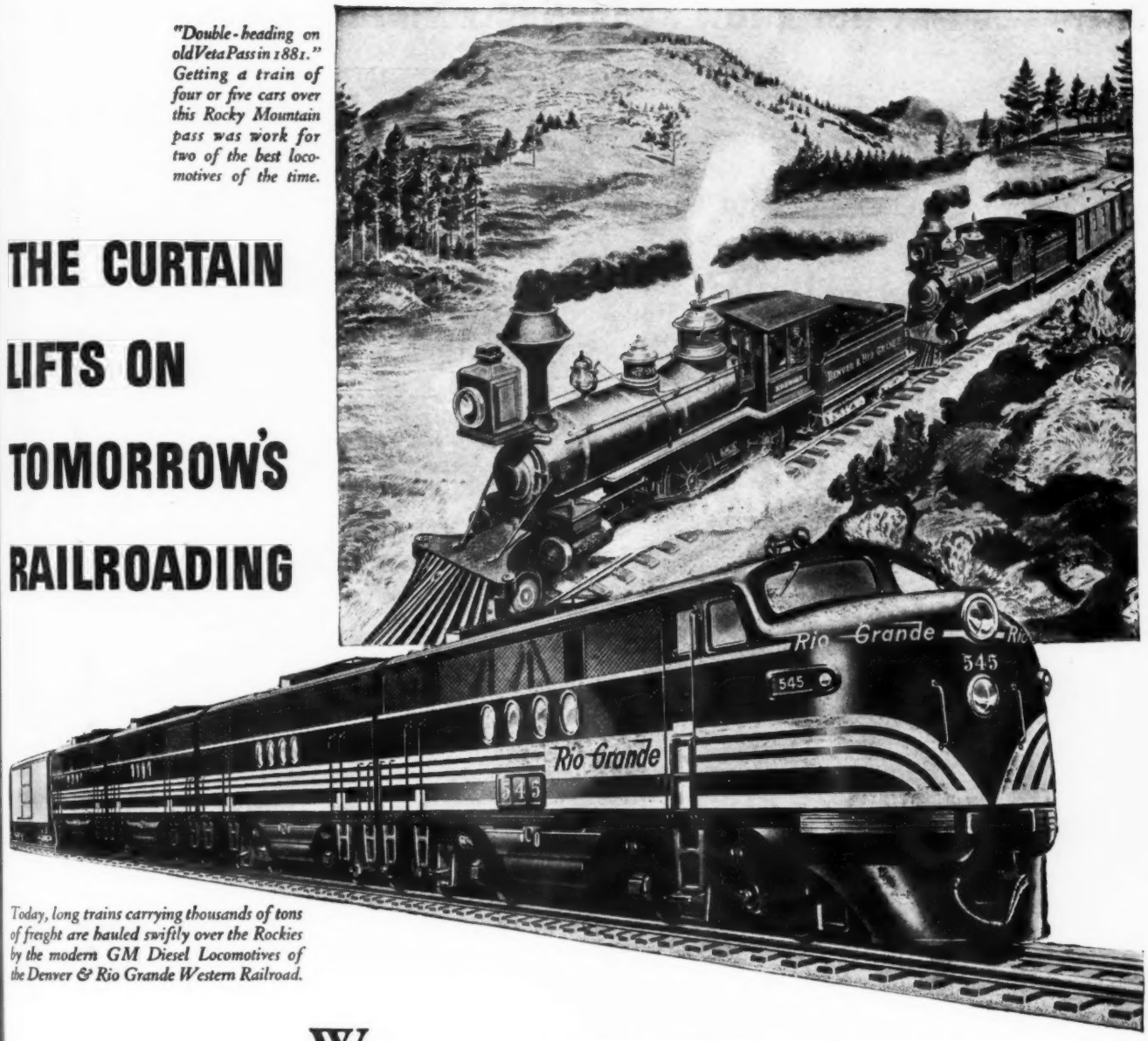
Goetze for GASKETS

*"Double-heading on old Veta Pass in 1881." Getting a train of four or five cars over this Rocky Mountain pass was work for two of the best locomotives of the time.*

# THE CURTAIN LIFTS ON TOMORROW'S RAILROADING




*Today, long trains carrying thousands of tons of freight are hauled swiftly over the Rockies by the modern GM Diesel Locomotives of the Denver & Rio Grande Western Railroad.*

WHEN you think of the Diesel locomotive, don't picture only the sleek, streamlined passenger trains which shorten distance and race the clock. Think too of the mainline Diesel freight locomotives which General Motors builds. These swift, dependable giants of power are contributing heavily to the astonishing war record of the railroads. They are raising the curtain on new standards of transportation keyed to the era which lies ahead.

GM
GENERAL MOTORS
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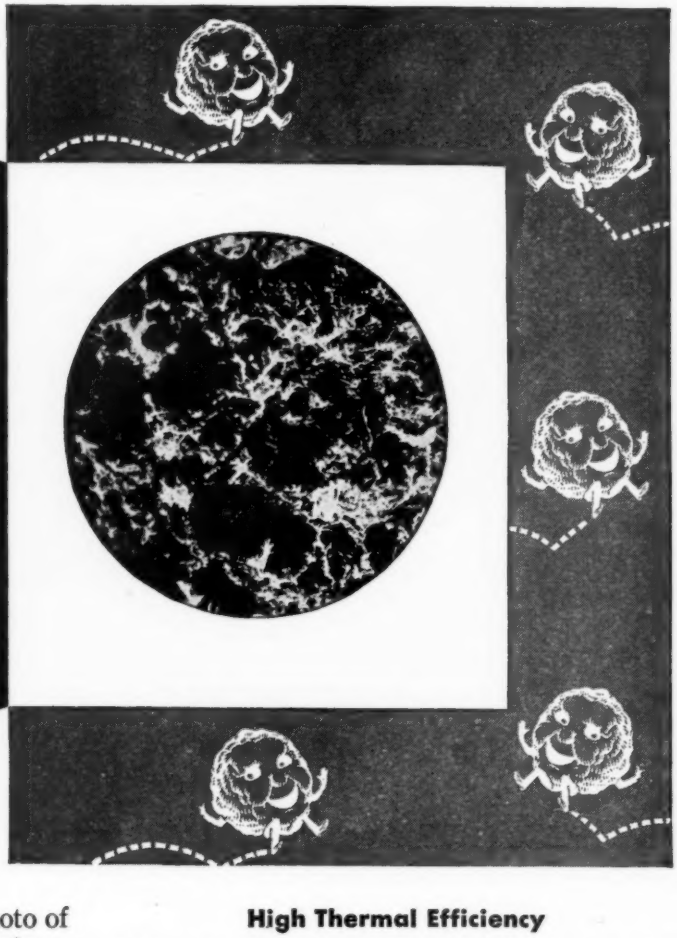
**FACTS YOU MAY NOT KNOW ABOUT EAGLE MINERAL WOOL INSULATION**

# These dead air cells saved a million dollars!



You are *not* looking at a photo of the moon, but at a photomicrograph of a pinch of Eagle Mineral Wool Insulation, whose structure permits retention of an infinite maze of tiny air cells—air cells being the most efficient insulation known to science!

Not only one, but many millions of dollars have been saved to industry in recent years by the almost incredible efficiency of Eagle-Picher High Temperature Insulations which are made from Eagle Mineral Wool.

**Eagle Super "66" Plastic Insulation**

Most versatile insulation in the Eagle-Picher High Temperature line is Eagle Super "66" Plastic Insulation, an all-purpose cement. This product, for use on heated equipment up to 1800° F., trowels on easily, forming a tight one-piece coat.

**High Thermal Efficiency**

This unique insulation combines "springy balls" of Mineral Wool with long asbestos fibres to make a cement of great pliability and resilience. Dry coverage is 50-55 sq. ft. 1" thick per 100 lbs. Shrinkage is negligible from wet to dry. When used at temperatures up to 1200° F., Eagle Super "66" can be removed, remixed, reused!

**Combats Rust, Corrosion**

Furthermore — in itself non-corrosive, Eagle Super "66" actually helps prevent rust on the surface to which it's applied.

* * *

***Write us for complete information on Eagle-Picher High Temperature Insulations, address Dept. P43. Current demand is great, but we are endeavoring to fill all orders without undue delay.***

## EAGLE-PICHER HIGH TEMPERATURE INSULATIONS

Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

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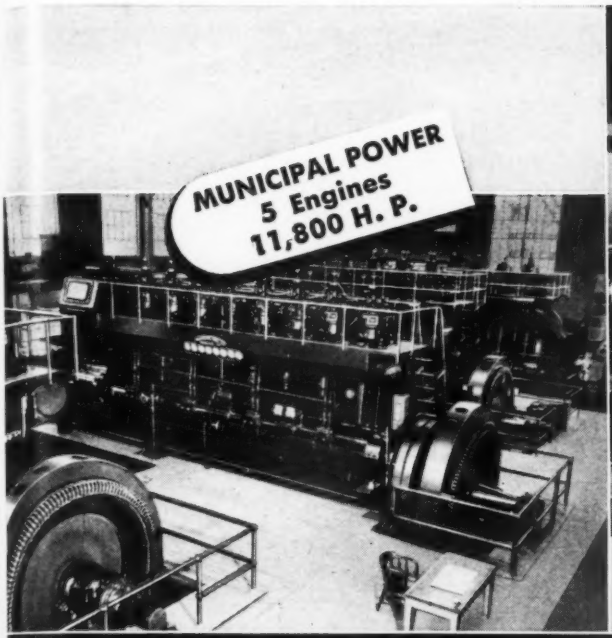
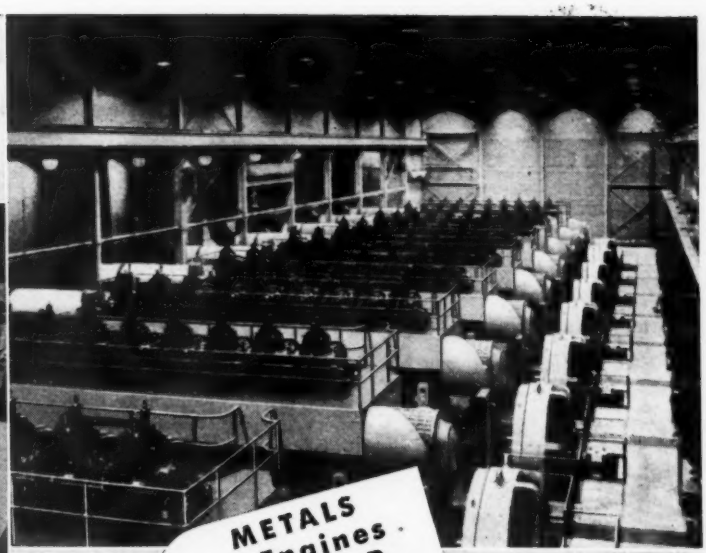
Eagle Finishing Cements
Eagle Loose Wool
Eagle Insulseal
Eagle Insul-stic

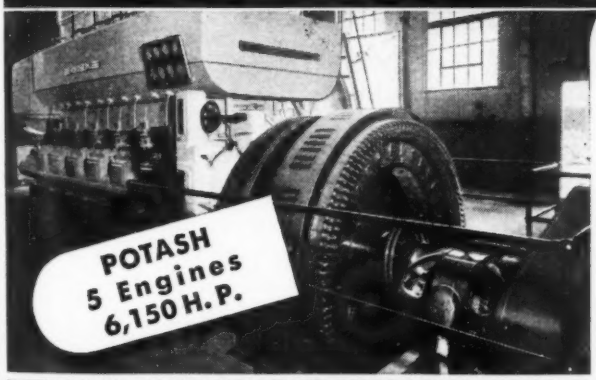
THE EAGLE-PICHER LEAD COMPANY, Cincinnati, Ohio

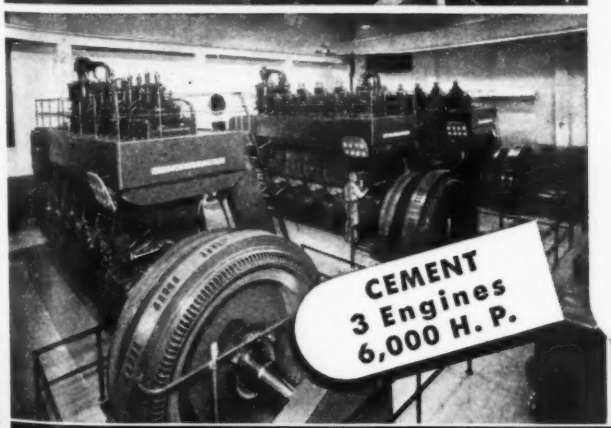



# NORDBERG Gas Burning Diesels

## *Offer Outstanding Advantages*



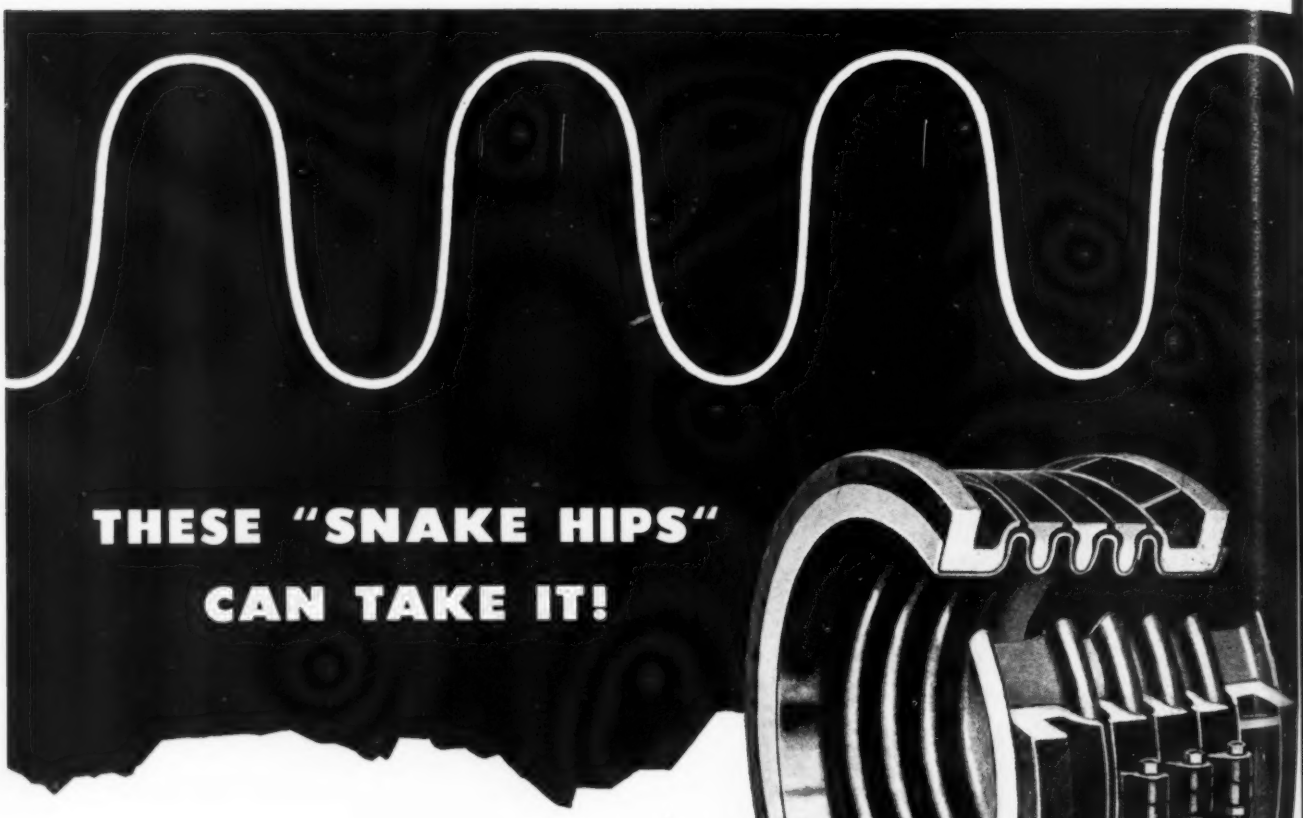




The successful performance of Nordberg Diesels operating on natural gas is evidenced by the number of units in service and the size of the individual installations. The world's largest Diesel engined plant totalling 65,000 horsepower is powered with eighteen Nordberg Gas Burning Diesels.

Since these engines operate on the full Diesel principle and without spark plugs or electrical ignition system, they burn gas with greatest efficiency and produce power at an exceptionally low cost. These engines have the further advantage in that change can be made from either gas or oil fuels without any change of major engine parts. In localities where natural gas is available, this exclusive Nordberg development has outstanding advantages to offer to power users.

**NORDBERG MFG. CO.**
MILWAUKEE 7, WISCONSIN

**NORDBERG**
**DIESEL ENGINES**



# THESE "SNAKE HIPS" CAN TAKE IT!

ALL-CURVE corrugations and DIRECTED FLEXING give Badger Packless Corrugated Expansion Joints even-flexing performance that is simply unattainable with corrugations having straight sides, angles or "junctions."

With the support of Badger Equalizing Rings, Badger ALL-CURVE corrugations absorb stresses uniformly over a maximum area. These rings—with contacting surfaces likewise "all-curve"—not only direct the flexing, but prevent excessive flexing by keeping it within prescribed limits. No early weakening of metal structure from heavy or localized stresses!

***Packless design.*** One-piece construction of the corrugated member—from a single piece of Copper or Stainless Steel tubing—provides an additional means of efficiency and economy of inestimable value. . . . No packing maintenance is required—and consequently no manholes are needed for that purpose in underground construction.

***Compact,*** too! No wasted space—since Badger Joints take up no more room than a comparable flanged fitting. Many years' experience in working sheet metals contributes further to making Badger Directed Flexing Packless Expansion Joints the most durable and dependable products of their kind!

E. B. BADGER & SONS CO., 75 PITTS ST., BOSTON 14, MASS.
*AGENTS IN PRINCIPAL CITIES*

## BADGER CORRUGATIONS

are produced under a special Badger forming process that minimizes forming stresses. An exclusive Badger-controlled heat-treatment preserves the flexing characteristics of the metal. Made for both normal and higher pressures; with one or multiple corrugations—for traverses ranging from small fractions of an inch to any practical limit; with flanged or welding-end nipples; in Self-equalizing (with rings) or Non-equalizing (ringless) type; in Copper, Stainless Steel or other metals to meet various conditions of temperature, pressure and corrosion.

• • •

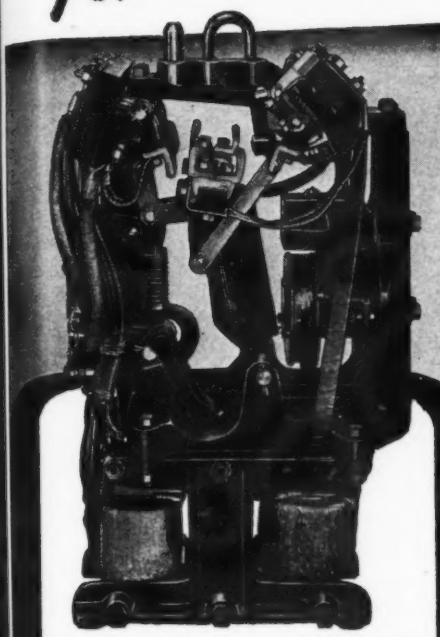
FREE BULLETINS: *No. 100 on Self-equalizing; No. 200 on Non-equalizing. Questions cheerfully answered; requirements analyzed. No obligation.*

# Badger

• IF IT'S BADGER-MADE IT'S GOT SOMETHING!

PACKLESS CORRUGATED EXPANSION JOINTS

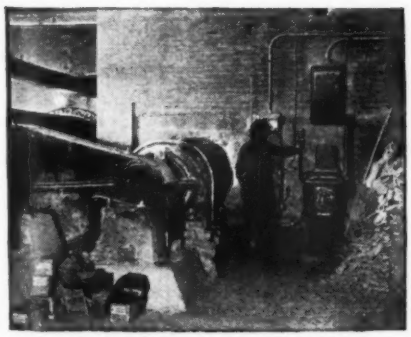
# EC&M REDUCED VOLTAGE STARTERS for 110-550 Volt MOTORS



**COMPENSATOR MECHANISM**
Single, quick-break, double-throw Contactor operated by a single magnet. Quick transfer from reduced voltage starting to full voltage running by a throw-over spring and a mechanical latch tripped by a current limit relay.

Bulletin 1045-A

Complete unit with conduit-connection box at rear and overload relays under cover-hood.



**PUSH BUTTON OPERATED**

HERE'S a starter that is very popular with operating and maintenance men. It is not an adaptation of contactor-equipment, but a simple, completely wired unit, totally enclosed and oil-immersed in a steel tank.

Total oil-immersion of the compensator-mechanism not only permits interrupting the circuit under oil (recognized as an effective means for breaking alternating currents) but also provides continuous lubrication for all operating parts of the mechanism and protects them from dust, moisture and corrosion.

In over 1000 plants, these EC&M starters have provided fool-proof, dependable operation for a number of years. Bulletin 1045-A completely describes them. Write for your copy today.

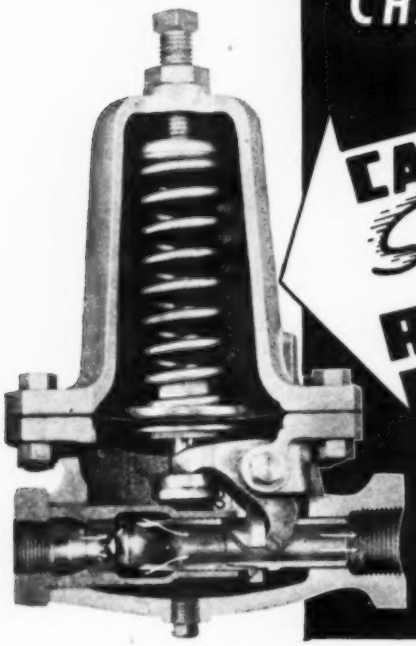
THE ELECTRIC CONTROLLER & MFG. CO.
2700 E. 79th St. ★ Cleveland 4, Ohio

# EVEN WITH SUPPLY LINE AND DEMAND CHANGES . . . . . .

## CASH STANDARD *Streamlined* PRESSURE REDUCING VALVE TYPE 1000

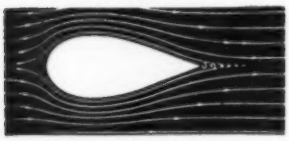
## . . . YOU HAVE SMOOTH ACTION AND CLOSE *Dependable* REGULATION

Available in sizes ¼" to 2" Each size with expanded outlet if desired.



● Flow has been streamlined for straight flow into the delivery passage and jet. See FIG. 1. The fluid

**FIG.-1**



flows smoothly around this valve with no back eddies to cause turbulence, See FIG. 2, on the downstream side of its trailing edge. In a reducing valve all the pressure drop or work of pressure reduction should occur at one place, namely where the valve throttles flow, and not on the downstream side of the valve. Where you have downstream turbulence, See FIG. 2, the greatest amount of turbulence with resultant greatest pressure drop will occur when you want maximum flow and therefore want least pressure drop—if the delivery pressure is to be maintained. With

**FIG.-2**

Streamlined Flow, See FIG. 1, you get maximum capacity, plus close delivery pressure control.

★ The "1000" Valve, streamlined for smooth, even flow of steam, water, air, oil, etc., reduces a higher pressure to a lower pressure. In this operation it holds the lower pressure constant regardless of variation in the initial pressure or variations in demand. The net results are no spoilage due to erratic pressure, and savings in operating and maintenance costs.

### *What Streamlined Flow Gives You in Benefits*

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

●

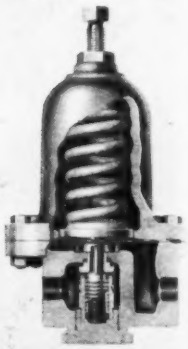
**WRITE FOR BULLETIN 1000**

Get details on the performance of this "Streamlined" 1000 Valve that insures maximum capacity—close delivery pressure control, and saves operating and maintenance costs.

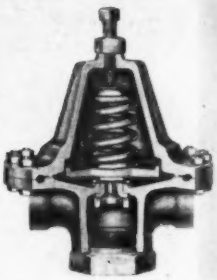
CASH STANDARD CONTROLS .. VALVES

**A. W. CASH COMPANY**
DECATUR, ILLINOIS

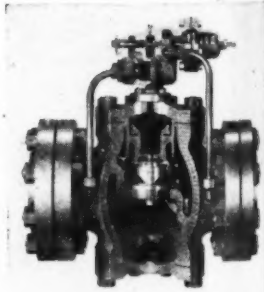
## OTHER VALVES *from the* CASH STANDARD LINE



High Pressure Reducing Valve Type H-P; extra heavy for use with initial pressures up to 5000 lbs.; and for reduced pressures up to 650 lbs. Good for most fluids. Sizes: ⅜" to 2"; bronze body; nitralloy trim. Get Bulletin 931.

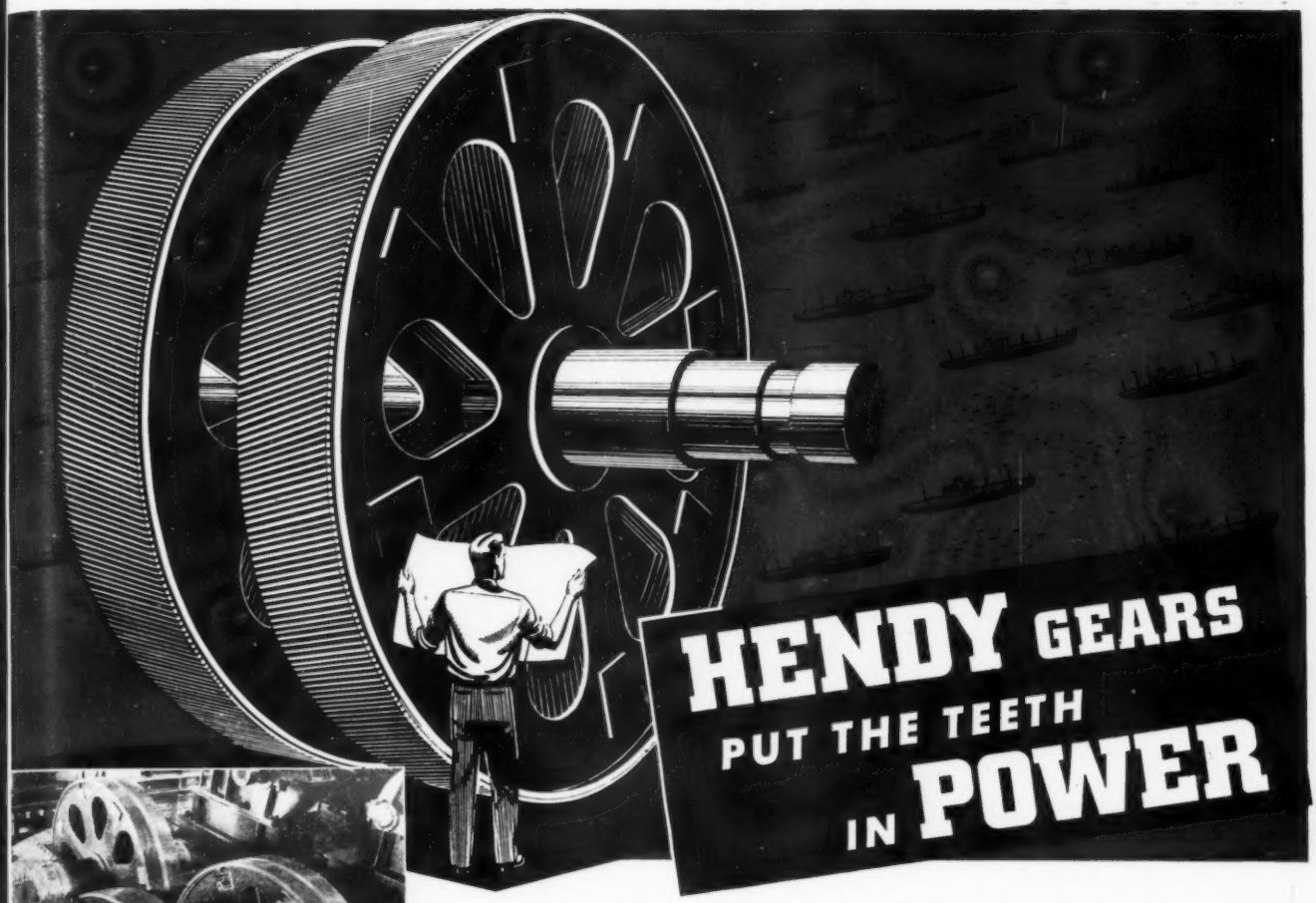


Type 8871 Pressure Regulator for dirty liquids (like Bunker C fuel oil). Inner valve is bolted to diaphragm for positive movement. Sizes ½" to 10". Bodies; iron, bronze, or steel. Seat ring and inner valve; stainless steel. Bulletin 972.

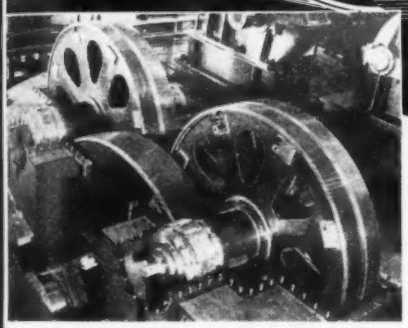


Cash Standard Type 10 Pressure Regulating Valve, pilot operated. (Pilot operating fluid discharged to outlet pipe; not wasted). Sizes: 2" to 12". Highest pressures: inlet 600 lbs.; reduced 250 lbs. Iron, bronze, or steel bodies; standard trims. For water, oil, non-corrosive gases and oils. Get interesting Bulletin 966.

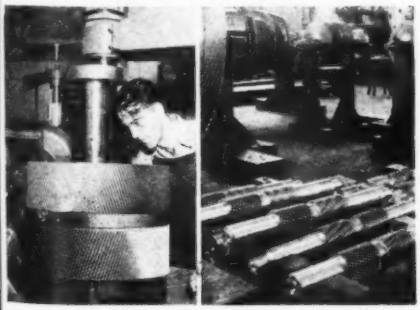
☆



# HENDY GEARS PUT THE TEETH IN POWER



Hendy engineers and builds a complete range of special speed reducers and speed increasers.



Small hobbing machine cutting 18.3 inch reduction gears for 300-K.W. turbo-generator. At *right*, assortment of pinions for various geared turbine units.

Hendy gears today are putting the "teeth" in the power that drives the greatest merchant fleet of all time—the American Merchant Marine—over all the oceans of the earth toward inevitable victory.

Soon Hendy gears will be available for rubber mills, paper mills, mines, factories, the countless industrial units that will rebuild the world of tomorrow. From new skill and increased capacity developed in war, Hendy will be able to supply a complete line of gears in all sizes up to 180" diameter and for any power capacity. High load capacity is a requirement of marine gears. Hendy industrial gears measure up fully to the standards set by Hendy marine gears.

## JOSHUA HENDY Division

### JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

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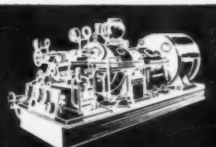
HENDY



TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES

● Infilco Water Conditioning Equipment can prevent the tragedies of boiler shut-downs, interrupted production, lost manhours, damage to vital power plant equipment and waste of precious fuel.

And—conditioning water against scale, corrosion, embrittlement, carry-over and oil—will pay for itself while speeding the war effort.

You are invited to make full use of Infilco's 49 years experience. Call on our engineers to help you in any problem of boiler or evaporator feedwater treatment, condensate oil removal, cooling water conditioning, or steam purification.

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INCORPORATED

**325 W. 25th PLACE, CHICAGO, ILL.**
***Formerly* INTERNATIONAL FILTER CO.**

INFILCO

ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
WATER FILTERS • CLARIFIERS • CO LING WATER CONDITIONERS
CONDENSATE FILTERS • STEAM PURIFIERS • HOT-FLOW SOFTENERS
LIME-SODA SOFTENERS • ZEOLITE SOFTENERS • CATEXERS

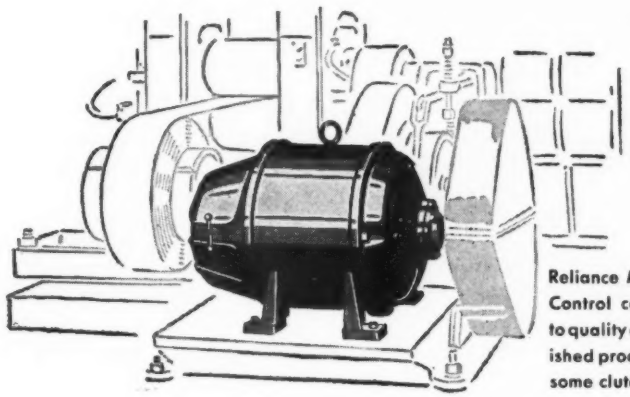
INFILCO

# TENSION!

Tension Control can be an important production factor in the processing of such materials as metals, paper and cloth, which are wound on drums or cores. Tight, evenly-wound rolls and uniformity of the finished product often depend upon it.

All of the characteristics necessary to maintaining proper and constant tension control are inherent in Reliance Electric Motor-Drive.

The pioneering work done by Reliance engineers in putting motor-drive to profitable use along these lines proves again that motor-drive *can* be *more than power.* The results of their experience are available to you at any time.



Reliance Motor-Drive for Tension Control contributes substantially to quality and uniformity of the finished product, eliminates troublesome clutches—and lowers costs.

RELIANCE A·C D·C MOTORS

**RELIANCE ELECTRIC & ENGINEERING CO.**

**1088 Ivanhoe Road • Cleveland, Ohio**

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S.C.) • Houston • Los Angeles • Minneapolis
New York • Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • San Francisco • Syracuse • other principal cities.

# FIT THE VALVE TO THE SERVICE

**WALWORTH**

## *Steeliron*

**LUBRICATED PLUG VALVES**

**No. 1796 — SCREWED**
**No. 1797F — FLANGED**

**No. 1796**

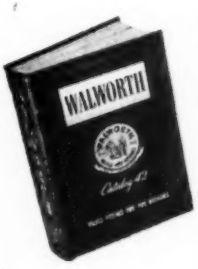
## for working pressures up to 175 lbs. O.W.G.

This Walworth lubricated plug valve meets a wide range of requirements, and also helps to conserve critical copper. Made of close-grained, high strength cast iron, it uses insoluble lubricants to assure tight-sealing, easy operation, and resistance to corrosion and wear.

When the lubricant screw is turned down, lubricant is forced under pressure through a system of grooves around the ports to the bottom of the plug. This seals the ports against leakage, and reduces friction between plug and body. The lubricant also protects plug and body against contact with line fluid, thus combatting corrosion.

Walworth Lubricated Plug Valves are particularly adaptable for the handling of gritty solutions and many other destructive erosive and corrosive industrial and chemical solutions. They are made in sizes from 1″ to 4″. Write for circular No. 91.

### SEND FOR CATALOG




*You'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 East 42nd Street, New York 17, N. Y. Department 15.*

BOSTON WORKS
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# WALWORTH
## valves AND fittings

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# THE M. W. KELLOGG COMPANY

***Fabricators and Erectors***

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**COMPLETE PIPING SYSTEMS**

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**HIGH PRESSURE — HIGH TEMPERATURE**
**PUBLIC UTILITY and MARINE POWER PLANTS**

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**PROCESS PIPING FOR INDUSTRY**

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**Heat Transfer Equipment for Industrial and Marine Power Plants**

**KELLOGG**

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

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REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND — TULSA: PHILTOWER BLDG.

# ...POWER PLANNING

## *For Reconversion of War Industries*

A tough job is ahead. The tremendous power for war time industries must be turned into power for peace. Unless the job is done and done well the entire economic framework of American industry may collapse.

Power planning should start now. But, until such time as actual reconversion is necessary, existing plants must be kept in top shape. The peak load is still to come. Careful maintenance and fuel saving are one, two, for the duration.

Postwar industry will require a greater variation of service and power to meet a diversified civilian production and decentralization. Competent engineering is essential. Theory and practice must combine. In this respect, J. F. Pritchard and Company Power Engineers are ready to help you with your power planning. From the fundamental prime mover through the ultimate power use, Pritchard Power Engineers can design, engineer and construct your power plant. J. F. PRITCHARD and COMPANY, *Power Division*, Fidelity Building, Kansas City, Missouri.

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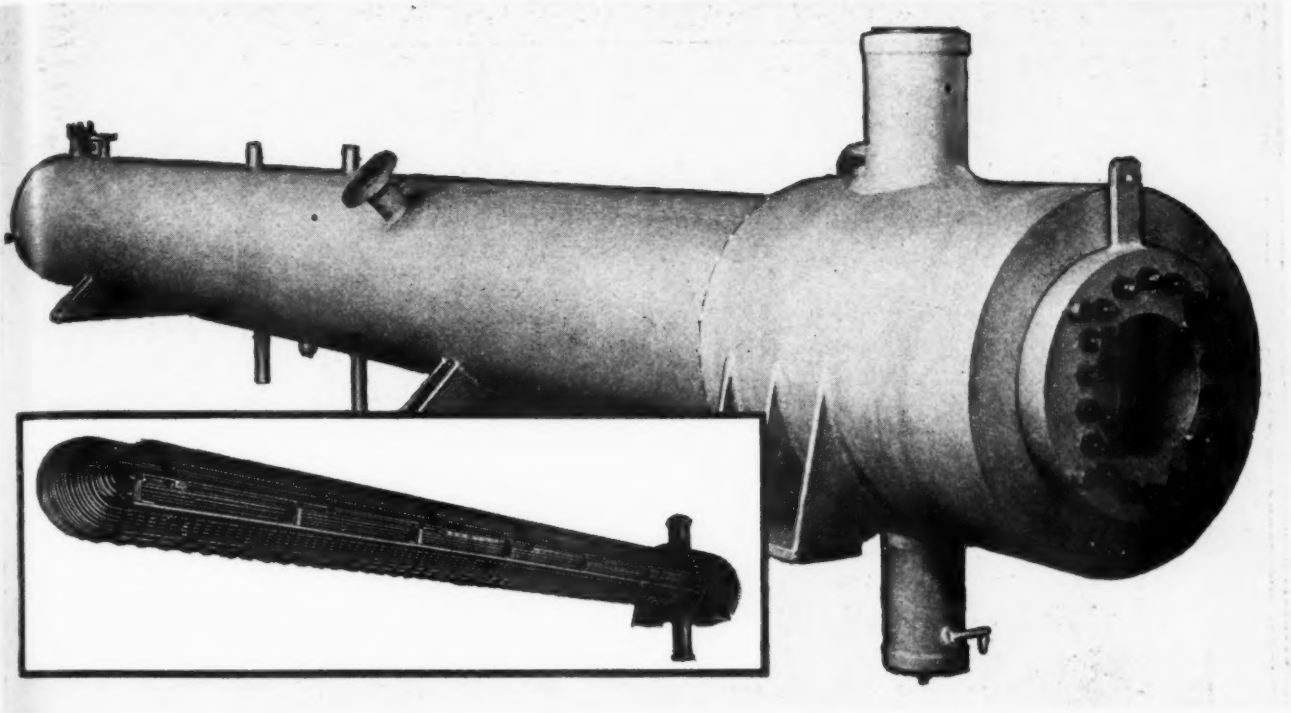
ENGINEERS AND CONSTRUCTORS

FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES

Manufacturers of Mechanical and Atmospheric Cooling Towers



# This G-R STAGE HEATER combines

**SIMPLICITY...** because the U-tube construction and tube sheet integral with water head requires a minimum of high pressure joints.

**RUGGEDNESS...** because of sturdy construction; including ample support of tubes, and prevention of vibration by minimum clearance at tube support plates.

**ACCESSIBILITY...** because the only high-pressure joint is a single manhole cover.

The design and construction of this unit is based on 76 years of experience in building heat transfer apparatus.

*Write for Bulletin*

The Griscom-Russell Co.
285 Madison Avenue
New York 17, N.Y.

# GRISCOM-RUSSELL

*Pioneers in Heat Transfer Apparatus*

# These Are Our Boys!

They've got a tough job ahead of them as they step out on this enemy beach. But we know they'll give 'em the works. And we'll give everything we've got back home, too—we'll work overtime without kicking, we'll go easy on gas and tires . . . and we'll buy War Bonds with every extra dollar. *They* are risking their lives . . . and we *must* do *our* part.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

## GARLOCK

Official U. S. Signal Corps Photo

# THE Preferred FLANGED JOINT
## FOR WELDED PIPING SYSTEMS

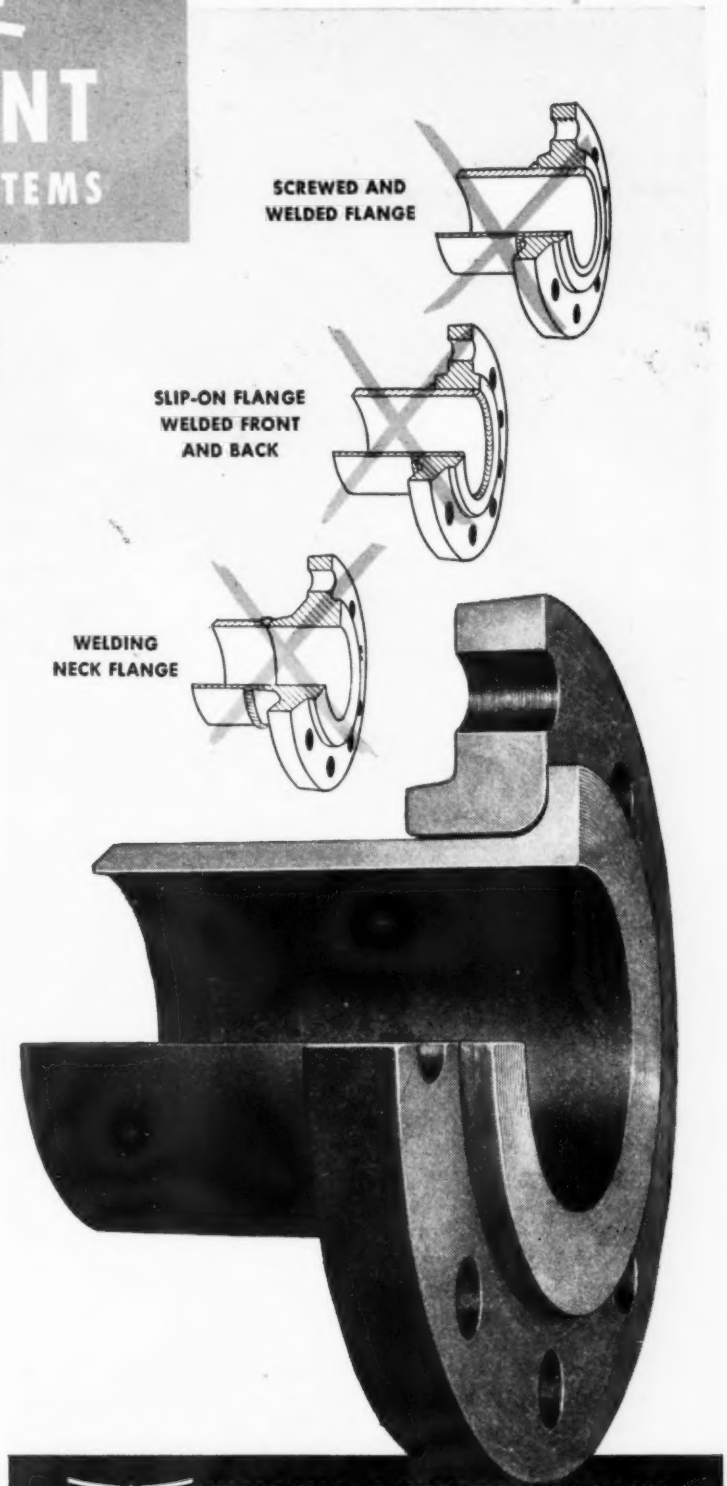
MIDWEST

# LAP-JOINT STUB ENDS

For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Lap-Joint Stub Ends have a tremendous advantage over flanges that are welded to the pipe (see drawings at right above). The swivel flange on the Stub End makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Lap-Joint Stub Ends in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

See Bulletin WF-41 for complete data regarding Midwest Lap-Joint Stub Ends . . . and the many other Midwest Welding Fittings that simplify and save on welded piping.




MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

MIDWEST PIPING & SUPPLY CO., Inc.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

**Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Building.**

# ARRESTS PROGRESSIVE WEAR

It is hard to conceive that contacting surfaces can be operated against each other and not cause wear. But tests prove this is not unusual when LUBRIPLATE Lubricants are used. This "Modern Lubricant" is more than top quality petroleum. It contains elements not found in any other oils or greases.

LUBRIPLATE maintains a wear-resisting, load-bearing film on shafts, bearings, gear teeth and other contacting moving machine parts. The destructive consequences of friction are therefore reduced to an unbelievable minimum. LUBRIPLATE protects machine parts against rust and corrosion. Its long life and stay-put properties make LUBRIPLATE very economical.

Don't take our word for the above statements. Let us send you data from scientific tests and case histories that prove that LUBRIPLATE arrests progressive wear. Write for a copy of "The LUBRIPLATE Film" written especially to serve your industry.

## Rx FOR YOUR MACHINERY

**No. 3**—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

**No. 8**—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

**No. 107**—One of the most popular grease type products for general application by pressure gun or cups.

**No. 70**—For a wide range of grease applications, especially at temperatures above 200 degrees F.

**No. 130-AA**—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

**BALL BEARING**—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

# LUBRIPLATE DIVISION

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NEWARK, N. J. **SINCE 1870** TOLEDO, O.

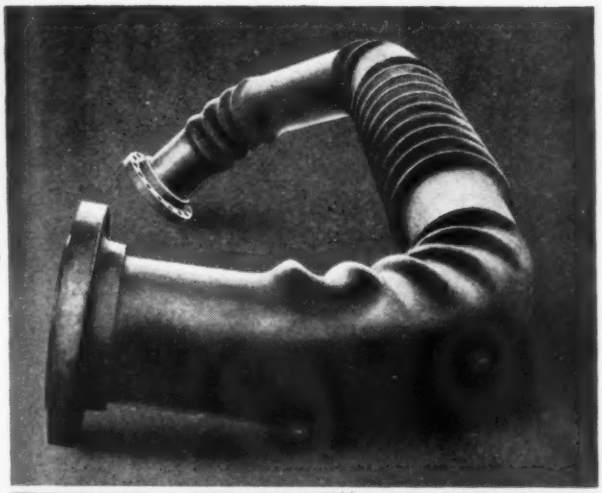
WRITE FOR THE NAME OF THE DEALER NEAR YOU

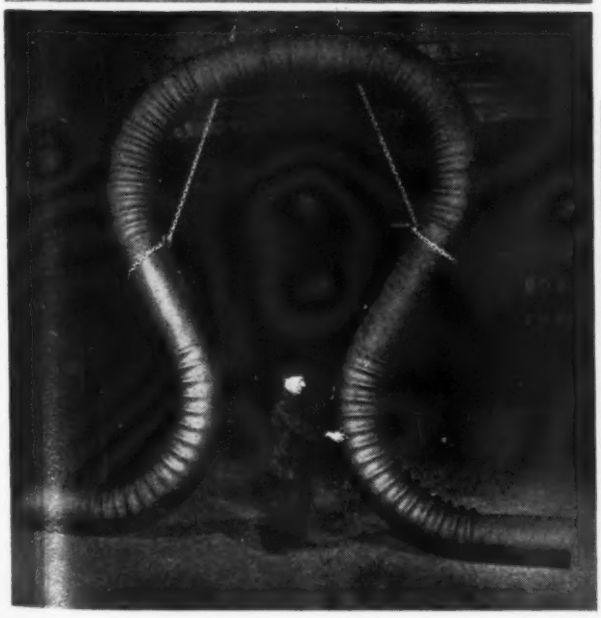
# PIPING FACTS

by PITTSBURGH PIPING AND EQUIPMENT CO.

## Creased Bends and Corrugated Tangents

## SIMPLIFY DESIGN
## IMPROVE OPERATION
## EFFECT ECONOMY

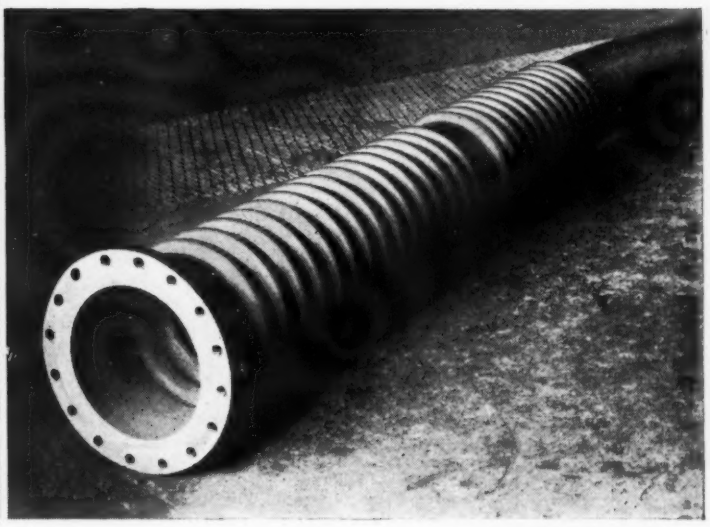




THROUGH the proper use of creased bends and corrugated tangents, movement in a piping system caused by thermal expansion can be held to a minimum.

The inherent flexibility of this type of piping makes possible the use of shorter lines without causing excessive stresses or end reactions against equipment . . . permits the use of short radius bends . . . provides for more convenient location of valves . . . the net result being a more compact, efficient, and economically operated system.

As the illustrations show, Pittsburgh Piping & Equipment Company's creased and corrugated construction is applicable to practically any piping design. Contact our nearest representative or write us direct.



Pittsburgh Piping

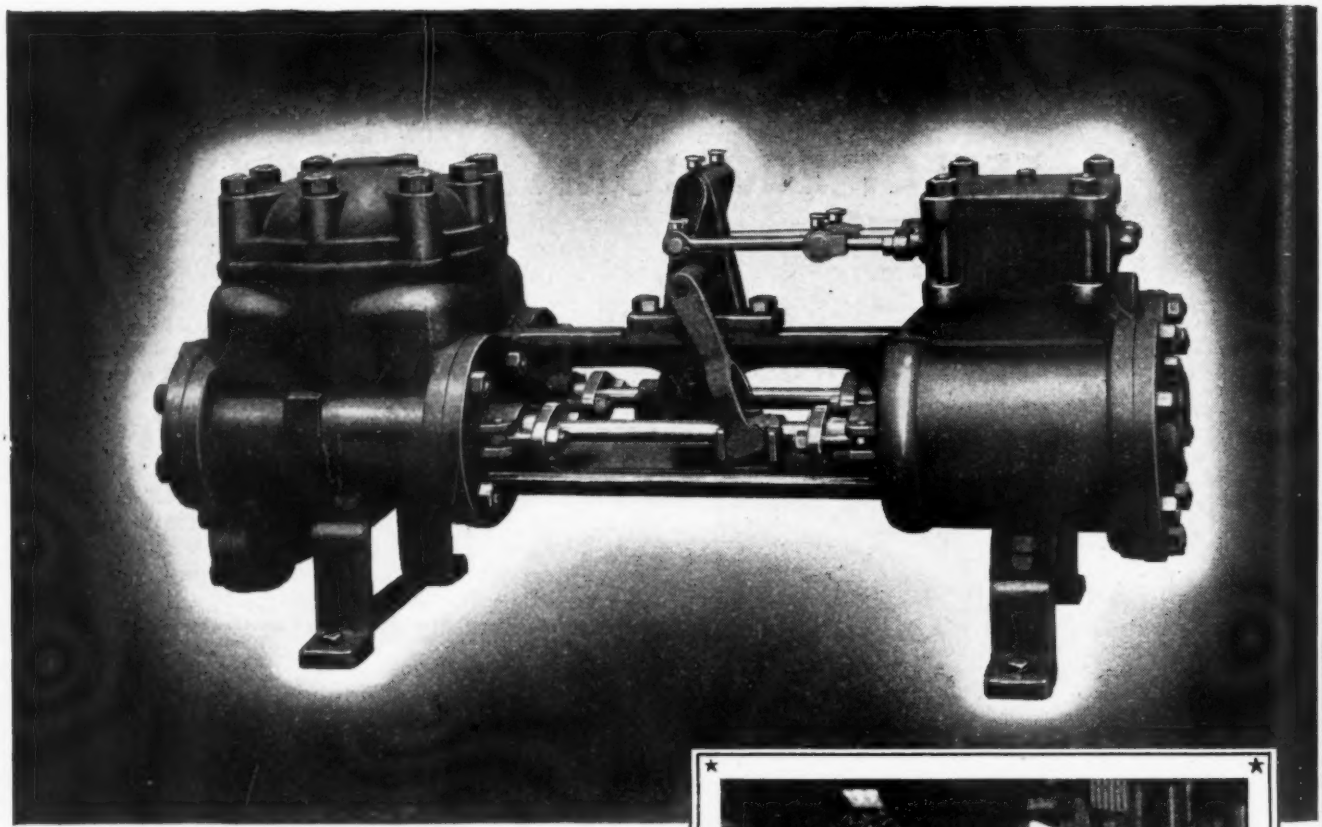
*Back The Attack—With War Bonds*

**AND EQUIPMENT COMPANY**

**10 Forty-Third Street · Pittsburgh · Penna.**

Woolworth Building, New York · Occidental Building, Indianapolis · Peoples Gas Building, Chicago · Book Tower, Detroit
Public Square Building, Cleveland · · 10 High Street, Boston · · 525 Market Street, San Francisco

# *A Pump With A Future That's Beginning Right NOW...*



## . . . . Check The Features of This WARREN REALWEAR Horizontal Duplex Piston Pump

Here's good news for Industry . . and Post-war Planners! The Realwear Type of Warren Pumps are becoming available in standard sizes again in limited quantities for commercial uses.

Warren Realwear Horizontal Duplex Piston Pumps have made unusual endurance records, low maintenance records and operating efficiency records. Like all Warren Pumps they are "built to fit the job" . . . with no compromising with sound engineering and construction features. And as an added PLUS value, extra wear and corrosion resistance is **standard** with these Warren Realwear Pumps.

Check over the following features of these pumps.

- One-piece type stainless steel piston rods
- Engine-type stuffing boxes, with glands held by swing bolts
- Renewable bronze bushings for valve gear links
- Multi-disc type pump valves of stainless steel
- Valve stems protected against wear by renewable bronze sleeves
- Centrifugally cast bronze cylinder liners

Investigate the Warren Realwear Pumps for **your** plant. Send for more information . . or write for bulletin or Warren catalog.

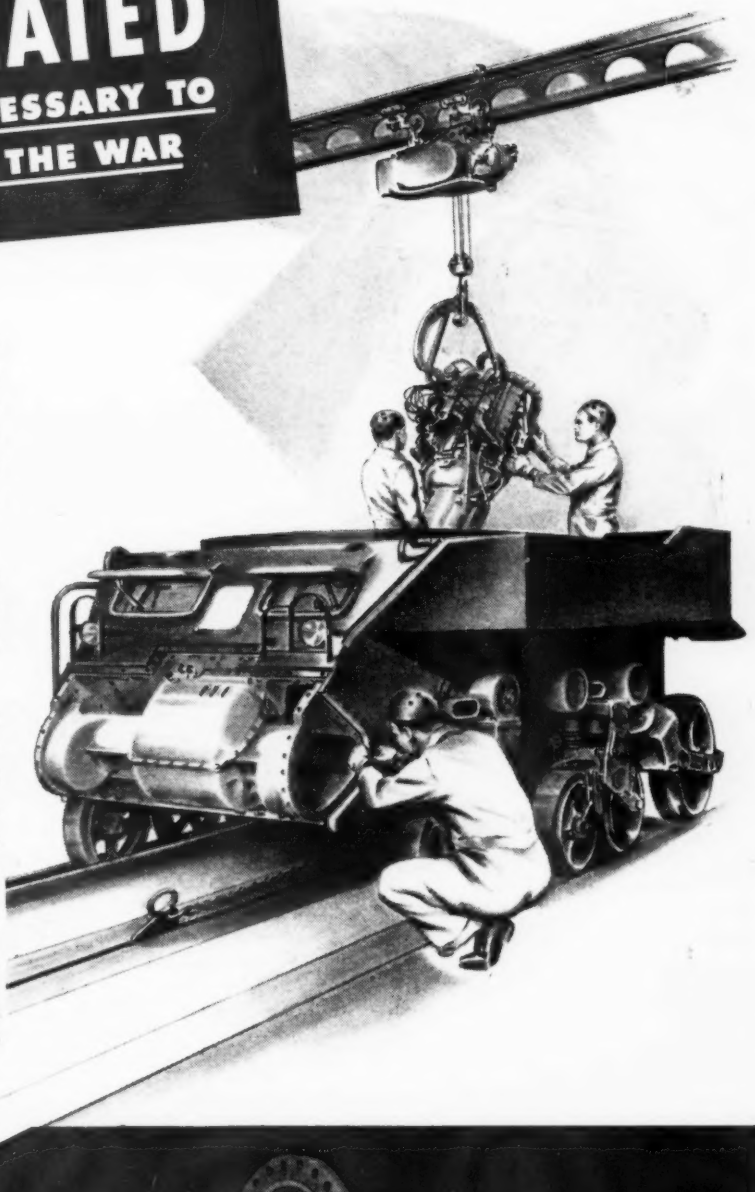
WHEN OUR COUNTRY WAS ATTACKED our Navy . . Army . . . Merchant Marine and War Industries needed more and more Warren Pumps — and Warren has been "all-out" ever since. It is the pride that our skilled workers take in Warren Pumps that enable Warren Equipment to perform so faithfully under the do-or-die conditions of war production and battle. And it is this pride that enabled Warren Workers to win the Army-Navy "E" Award — at the presentation of which this picture was taken.

ARMY E NAVY

**WARREN STEAM PUMP CO., INC.**
**WARREN, MASSACHUSETTS**

*Like Pre-Fabricated Tanks . . . .*

# PRE-FABRICATED PIPING IS NECESSARY TO WIN THE WAR

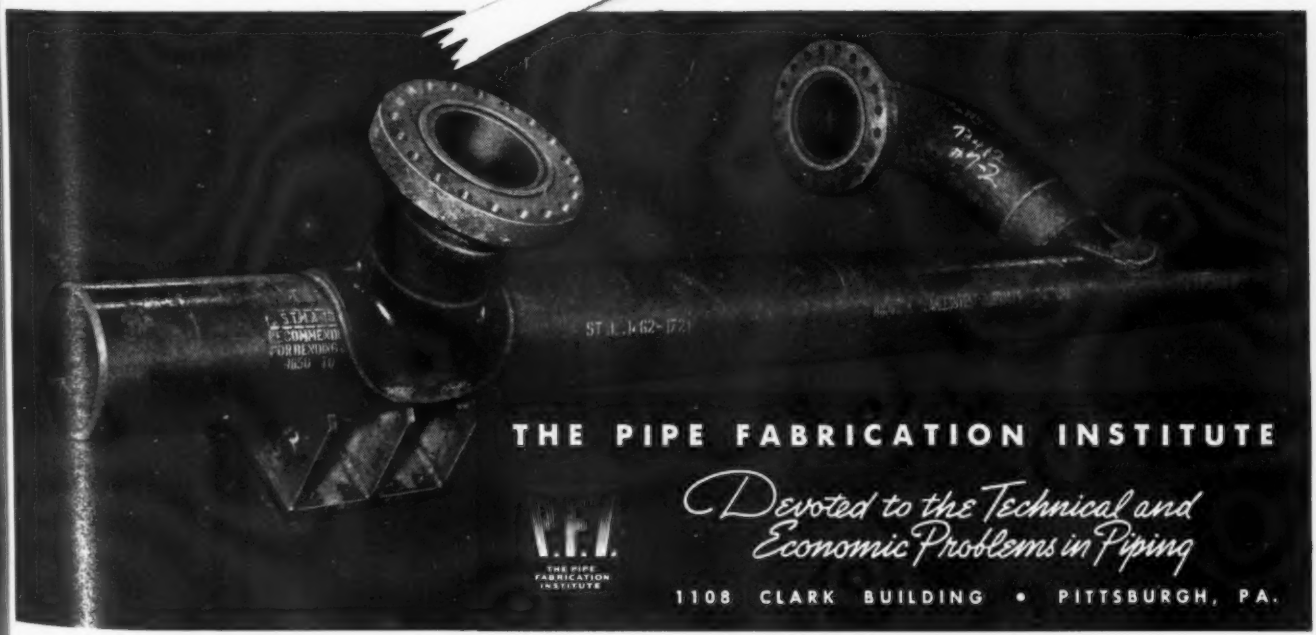


Tank builders have made clever use of many specialists to speed production and improve the quality of this vital war product. Important tank parts are pre-fabricated by other plants with long experience in these particular types of work. These subassemblies are then delivered to the tank plant ready for installation.

Had this procedure not been adopted, our present high production and high quality of tanks would have been difficult or impossible to attain.

Pre-fabrication meets a similar need in piping. Qualified pipe fabricators deliver the piping in a series of subassemblies having all difficult operations performed. These subassemblies are commercially practical, heat treated and stress relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected.

The resulting saving in time of erection and assurance of quality piping have made a vital contribution to the speed with which war plants have been put into production . . . and to their dependable operation.



**THE PIPE FABRICATION INSTITUTE**

*Devoted to the Technical and Economic Problems in Piping*

1108 CLARK BUILDING • PITTSBURGH, PA.

# Balanced Flow

## WAS A TURNING POINT IN SURFACE CONDENSER DESIGN

ROSS

When Ross introduced Balanced Steam Flow, by means of split tube support plates, it was a great turning point in Surface Condenser design. For the first time, a simplified system for equalized pressure through the bundle was achieved, embodying these outstanding features:

★ Congestion at entrance to a cool section relieved

★ Pressure loss across any portion of the bundle reduced to a minimum

★ Practically uniform pressure drop for all paths through the main tube banks

★ Entire surface able to condense steam actively with the maximum possible temperature difference

Because of these outstanding advantages, more and more condenser manufacturers are turning to split tube support plate construction.

So, again an early Ross discovery (introduced simultaneously with Ross divided tube banks) has influenced the trend of modern Surface Condenser design . . . another "First" accounting for Ross leadership today!

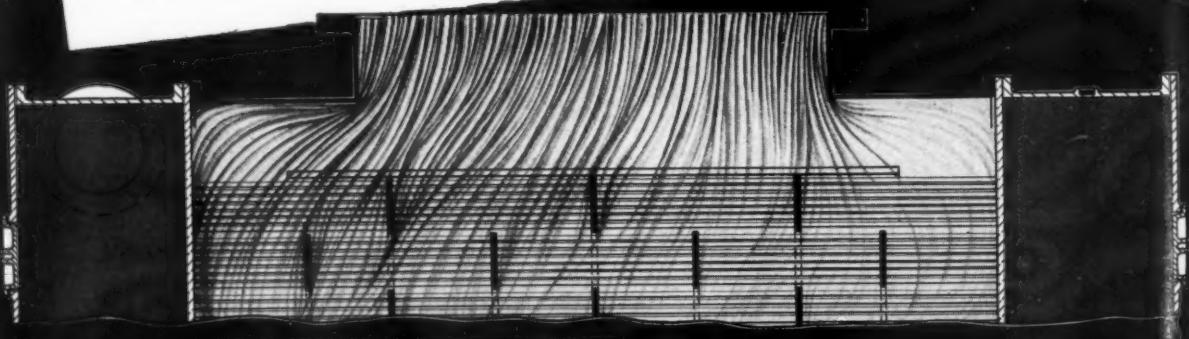
**ROSS HEATER & MFG. CO., Inc.**

Division of American Radiator and "Standard" Sanitary Corporation

GENERAL OFFICES & PLANT

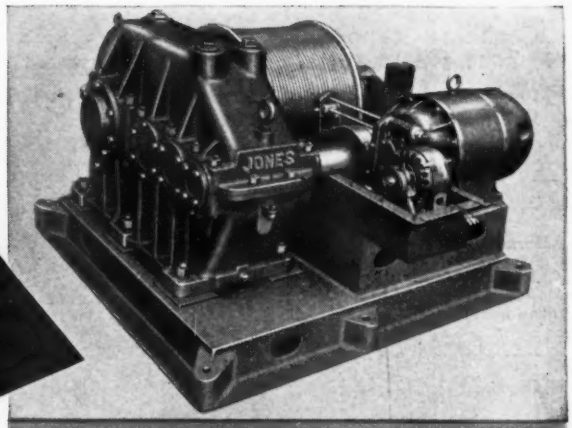
1415 WEST AVENUE BUFFALO 13, N. Y.

Divided and Offset Tube Support Plates, Condensate Trays and Air Cooler Shells.



Balancing Flow within the Tube Bundle

# When the drive is built into the unit

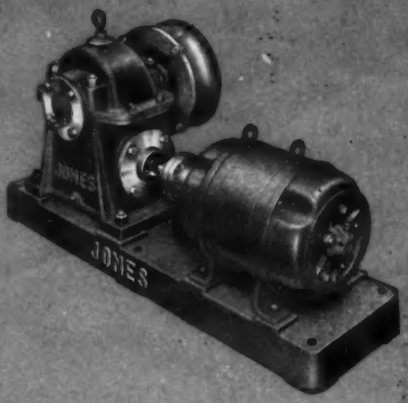



● Jones Skip Hoist Drive built as a complete unit by the Jones organization in several types with base to take any motor specified by the purchaser. This drive is equipped with all the modern protective devices such as cam or nut type limit switches, solenoid or disc type brakes and slack cable switches. The drives are single, double or triple reduction Jones Herringbone Speed Reducers.

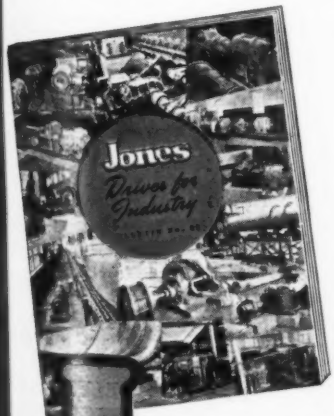
FOR many years the Jones organization has been developing various types of drive units in which Jones special or standard speed reducers form an important integral part of the unit.

The car puller, door hoist and skip hoist drives illustrated and described here are typical specimens of Jones Unit Drives. These machines are built as complete units by the Jones organization with base to take any motor specified by the purchaser.

The Jones organization has also worked with a great many manufacturers in the application of Jones gears and speed reducers to an extremely wide variety of complete assemblies. You are invited to make full use of this experience in connection with any power transmission problems that you may have.

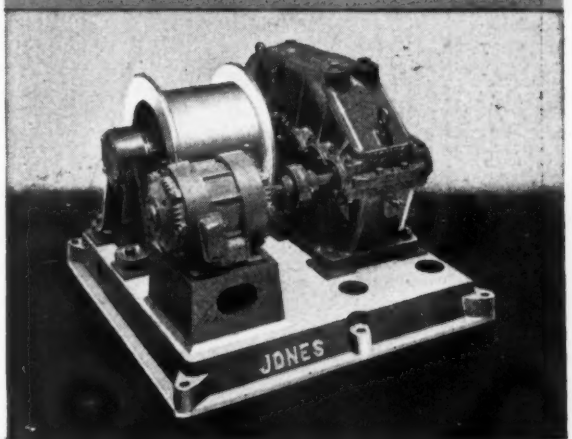



● Jones door hoists are built in many ratings and may be installed with almost any convenient arrangement of sheaves and cables. Base will take any standard motor. No limit switches of any kind are required with this unit.




**W. A. JONES FOUNDRY & MACHINE CO.**
**W. Roosevelt Road**
**Chicago, Illinois**

Bulletin No. 80, "Jones Drives for Industry", may be helpful in giving you a complete picture of the Jones products, engineering services and manufacturing facilities that are available for helping you solve your drive problems.




● A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

# Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

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## Will CARBONACEOUS ZEOLITES apply to your softening problems?

Cochrane's new Publication 4021 contains a wealth of material of great value in estimating the applicability of this system in the solution of your water conditioning problems.

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# COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

# ROCKBESTOS A.V.C. Wires and Cables

## Provide the most direct approach to eliminating wire failures in lighting, control and power circuits

**THE ROCKBESTOS CONSTRUCTION THAT PROVIDES LONG WIRE LIFE***

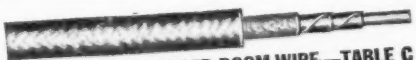
1. The conductor is perfectly and permanently centered in helically applied insulation.
2. Impregnated felted asbestos insulation withstands conductor-heating currents and won't burn, even under overloads up to the melting point of copper.
3. Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat, flame and oxidation between two felted asbestos walls.
4. Outer felted asbestos wall impregnated with heat, flame and moisture resistant compounds serves as a heat-barrier against high ambient temperatures.
5. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

**One of 122 different wires and cables developed for severe operating conditions by Rockbestos.*

***WON'T bake brittle, bloom, burn or rot.***

***RESISTS moisture, oil, grease and fumes.***

Rockbestos A.V.C. Power Cable above and similarly insulated Motor Lead Cable (Underwriters' and Nat. Elec. Code, Type AVA) has a maximum operating temperature rating of 110° C. (230° F.) and this permanently insulated construction. See detail, upper left.



**600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C**
**(Underwriters' Type AVA)**

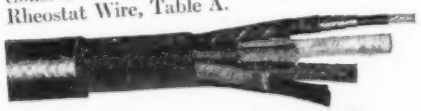
*Sizes No. 18 to 4/0 AWG. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor.*

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal.

**600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R**
**(Underwriters' Type AI)**

*Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of impregnated asbestos, covered with a rugged asbestos braid in black, white or colors.*

Use this power and rheostat cable for wiring rheostats, elevator and locomotive control panels, and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.



**600 VOLT A.V.C. CONTROL CABLE**

*In one to 19 conductors. Standard stranding AWG No. 12—19/-25 and No. 9—19/-22. Other strandings furnished on order.*

Designed for use under conditions too severe for control cables with other insulations which deteriorate rapidly when exposed to high temperatures. Operates without failure under attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

**FOR VICTORY BUY WAR BONDS**

There are two ways to practically eliminate wire-failures in electrical circuits around furnaces, soaking pits, steam tunnels, lehrs, kilns and other high temperature locations. One is to move the circuits away from the "hot-spot" area, but that might be impossible or too costly. Another, is to install wire with an insulation that is unaffected by heat and built to stand up under severe operating conditions.

Rockbestos A.V.C. wires, cables and cords are designed and constructed to provide lasting trouble-free performance. They stand up where other wires fail because the *permanent* impregnated asbestos insulation resists heat and moisture, oil, grease, alkalies and corrosive fumes, and won't bake brittle, crack, flow, rot or swell.

Get the facts on Rockbestos A.V.C. See for yourself how these *permanently insulated* wires and cables keep wire-failure down to the minimum in lighting, power and control circuits. When inquiring or ordering, please furnish CMP allotment number and certification. For complete information and samples, write nearest branch office or:

**Rockbestos Products Corporation, 927 Nicoll Street**
**New Haven 4, Conn.**

# ROCKBESTOS A.V.C.

## *The Wire with Permanent Insulation*

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.

# *No defective billet can crash this line*

## . . . that's why you can always depend on the uniform high quality of

## WOLVERINE condenser tubes

Here's a line of real All-American caliber—a line that presents an impregnable defense to any defective condenser tube billet.

We call your particular attention to the center position, the Wolverine Inspection-*before*-Extrusion process. This player was developed by Wolverine, and is one of the most important members of the team. He plays in every game, every year.

His job is to watch for flaws *before* any billet enters the extrusion press. And if he finds a flaw—well, that billet is immediately thrown for a loss.

After years of developing and perfecting the extrusion method of making condenser tube, this Inspection-*before*-Extrusion is still the only sure way we know to guard against flaws entering the finished tube.

So if you want condenser tubes of high uniform quality,—quality that is now controlled from ore to finished product—put Wolverine on your schedule.

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

**WOLVERINE TUBE DIVISION**

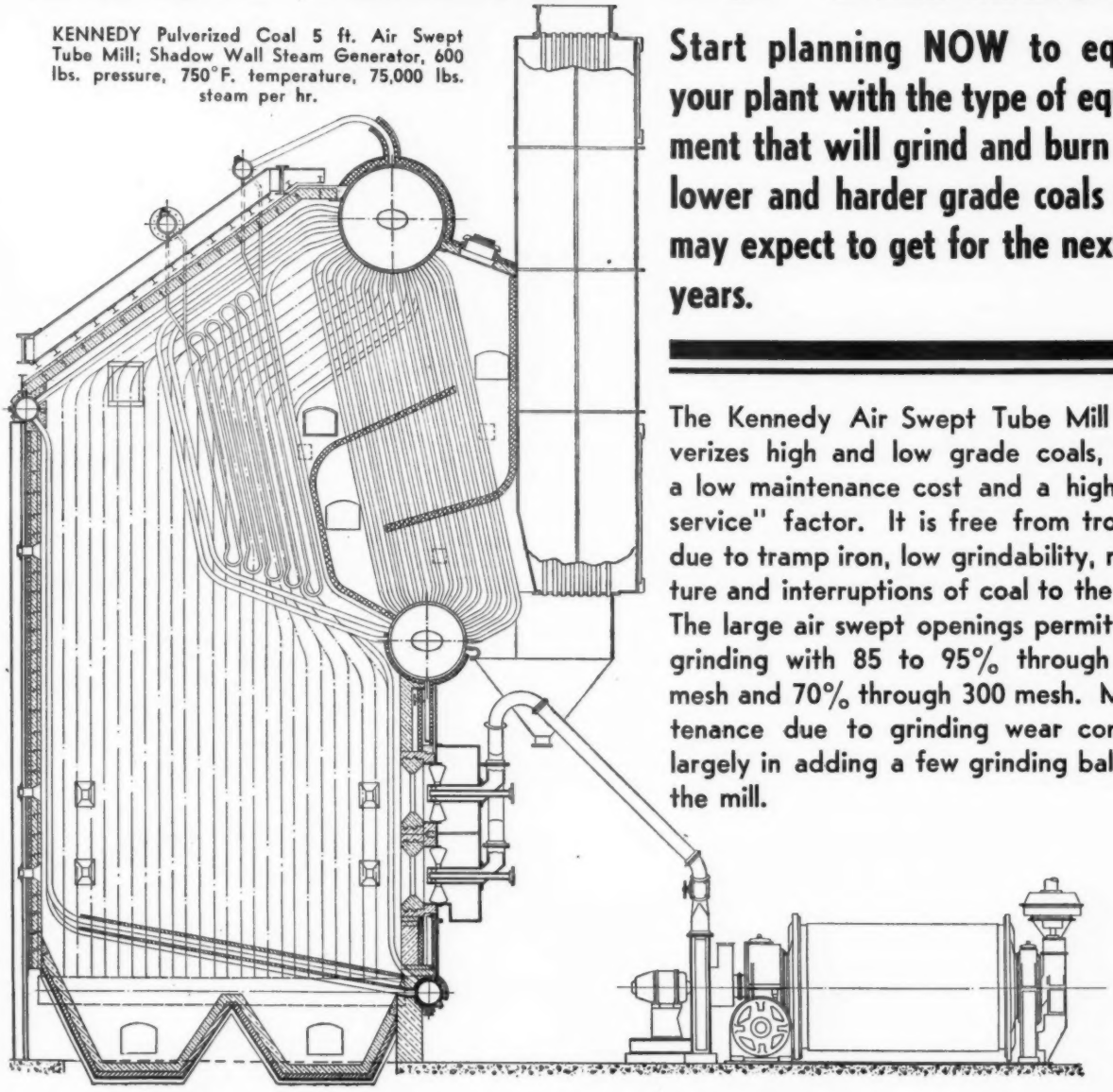
*Seamless Copper — Brass*

1435 CENTRAL AVENUE DETROIT 9, MICHIGAN

*Are you having trouble getting the kind of coal you want?*

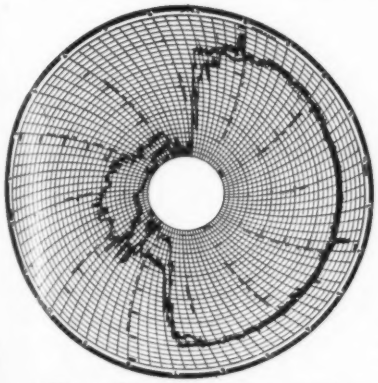
# LOOK AHEAD 10 YEARS!

KENNEDY Pulverized Coal 5 ft. Air Swept Tube Mill; Shadow Wall Steam Generator, 600 lbs. pressure, 750°F. temperature, 75,000 lbs. steam per hr.



**Start planning NOW to equip your plant with the type of equipment that will grind and burn the lower and harder grade coals you may expect to get for the next 10 years.**

The Kennedy Air Swept Tube Mill pulverizes high and low grade coals, with a low maintenance cost and a high "in service" factor. It is free from trouble due to tramp iron, low grindability, moisture and interruptions of coal to the mill. The large air swept openings permit fine grinding with 85 to 95% through 200 mesh and 70% through 300 mesh. Maintenance due to grinding wear consists largely in adding a few grinding balls to the mill.



A 10 to 1 load change in 17 minutes; boiler efficiency 87%.

The Kennedy Shadow Wall Steam Generator gives you low cost steam. Its full floating drum suspension, with the tubes hung free from the brickwork, permit movement of the tubes without cracking the setting. The waterwall tubes form a shadow wall absorbing radiated and reflected heat, resulting in low refractory temperatures, with a low maintenance cost. Large waterwall headers permit blow down at maximum rating without interrupting circulation.

**Write for our Bulletin 12—also for our Bulletins on Drying, Grinding and Burning Low Grade Anthracite Coal.**

**Kennedy-Van Saun**
MANUFACTURING AND ENGINEERING CORPORATION

No. 2 PARK AVENUE, NEW YORK 16, N. Y.

# WeldELLS have everything*

## "You said it, brother—EVERYTHING!"

His job is *welding;* not fooling around getting ready to weld.

He can put more time on actual welding when he uses WeldELLS:*

—Because their tangents make them easier to line up.

—Because their precision quarter-marked ends simplify layout.

—Because the size and thickness are permanently marked on every fitting.

He can turn out a better job, too, when he uses WeldELLS—thanks to their dimensional accuracy and to the machine tool beveled ends that provide an ideal welding surface.

And the features that mean so much to the welder are also vitally important to the men who engineer the job and those who live with it.

★ No other fittings for pipe welding combine these features found in WeldELLS:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress — simplify lining up.
- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

* WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

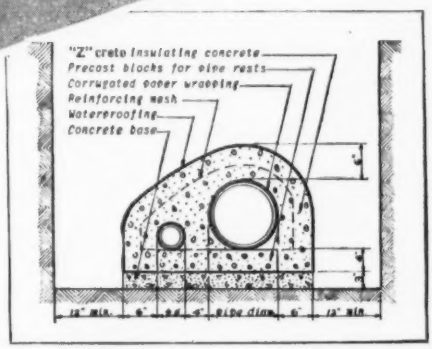
**TAYLOR FORGE & PIPE WORKS,** General Offices & Works: Chicago, P. O. Box 485

• The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

NEW YORK OFFICE: 50 CHURCH ST. • PHILADELPHIA OFFICE: BROAD ST. STATION BUILDING

# "Z"crete UNDERGROUND STEAM LINE INSULATION

# BETTER 6 WAYS!




Typical straight run with pipes side by side

The truly amazing "Z"crete system is the modern, superior method of insulating underground steam or other types of piping. It is a *new, fast, practical* way of installing insulation and offers many advantages.

**1** It creates a continuous, unbroken covering of insulation around the pipes which affords greater operating efficiency and greatly simplifies waterproofing.

**2** It forms a solid covering of permanent water-repellent insulation around the pipes which eliminates joints, hollow spaces or conduits which can fill with water should the waterproofing leak.

**3** It makes an embedment of insulation in which the pipes are buried that can be very simply and efficiently waterproofed on all sides at time of installation.

**4** It provides a highly efficient insulating material of a permanent nature composed of "Z"crete aggregate, Portland cement and a special integral waterproofing.

These materials combine to form an insulating concrete which is not subject to disintegration upon wetting, is fireproof, chemically inert, rotproof and integrally water-repellent.

**5** It minimizes the danger of damage to the insulation or waterproofing due to shipping or handling because both are installed after the pipe is laid.

**6** In short, it greatly simplifies the whole problem of installing and insulating underground pipe lines.

Completed "Z"crete System before backfilling

***For information and engineering data, write to***

**UNIVERSAL ZONOLITE INSULATION CO.**
**DEPT. P1, 135 S. LA SALLE ST., CHICAGO 3, ILL.**

**MAIL COUPON**

Universal Zonolite Insulation Co.
Dept. P1, 135 S. La Salle Street
Chicago 3, Ill.
Please send me full information about the "Z"crete systems for underground pipe insulation.

*Name*.....

*Address*.....

*City*.....*State*.....

# When the Insulation Job is BIG...

## When It Must Be Completed ON SCHEDULE

## ...You can rely on Carey SERVICE!

IN installing heat insulation in many of the nation's largest wartime chemical, petroleum, and power projects—jobs such as Charlestown, Kobuta, Childersburg, Rosemont—CAREY engineers and erection crews have set remarkable records for speed and efficiency.

CAREY has the experienced personnel to handle insulation jobs of any size or type—in a nationwide engineering and distribution service which is at your command *always*.

CAREY specially trained engineers and erection crews, backed by years of practical experience, have the expert "know how" that assures a *better* heat-insulation job, completed *on schedule*.

And just as the CAREY organization is your guarantee of getting insulation work done right and on time, super-efficient CAREY Heat Insulations are your best assurance of maximum performance and durability, utmost conservation of fuel, higher kilowatt output at lower cost.

For dependable Heat Insulation, efficient workmanship, and jobs completed "per schedule"—*look to CAREY!*

***Write for full details on Carey Heat Insulations. Address Dept. 16***

**THE PHILIP CAREY MFG. COMPANY, Lockland, Cincinnati, Ohio**

***Dependable Products Since 1873***

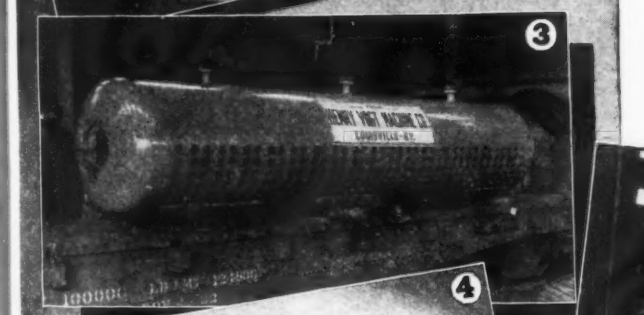
***In Canada:*** **The Philip Carey Company, Ltd. Office and Factory: Lennoxville, P. Q.**

***There's a Carey Heat Insulation for Every Need!***

| Careycel Insulation. For temperatures to 300°F. | 85% Magnesia For High and Medium Pressure. Temperatures to 550°F. | Combination Hi-Temp—85% Magnesia Temperatures to 1200°F. | Hi-Temp Blocks For Furnaces, Ovens, Kilns, etc. Temperatures to 2500°F. |
|---|---|---|---|

A.P.I.—A.S.M.E. and A.S.M.E. CODES • CARBON STEEL AND SPECIAL STEEL

# WELDED PRODUCTS by Vogt



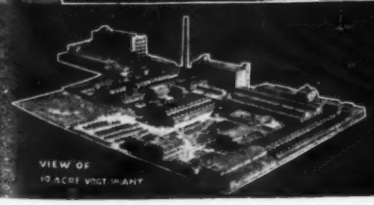
**1 -** 4′—0″ dia. x 7′—6″ dia. x 82′—5″ high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

**2 -** Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

**3 -** 48″ dia. x 22′—6″ long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

**4 -** Battery of Absorption Columns in a Western Refinery. Units are 33″ dia. x 41′—0″ high and were stress relieved after welding.

**5 -** 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.




## HENRY VOGT MACHINE CO.

Incorporated

LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK · PHILADELPHIA · CLEVELAND · CHICAGO · DALLAS

In War Industries and in Power Plants
In Fighting, Transport and Merchant Ships
In War Transportation, Locomotives and Other Units

# GLOBE STEEL TUBES IN GLOBAL-WAR SERVICE

The "emergency" found *Globe Steel Tubes* prepared...prepared because *Globe* engineers are veterans of more than 30 years' constant service on the pressure-tube "front."... Concentrating now, as always, on *Globe Quality* steel tubes, we faced no problem of "conversion" to meet the unprecedented demands of industry's war-production power plants...transport, merchant and warships...locomotives and other units of war power-equipment requiring super-quality and 24-hour-a-day operative ability in boiler tubes, condenser and heat-exchanger tubes, stainless and mechanical tubing.

*GLOBE engineers offer their long experience and superior facilities to aid you in selecting steel tubes of proper characteristics for your specific needs.*

★ STAINLESS TUBES
★ BOILER TUBES
☆ GLOBEIRON TUBING
★ GLOWELD TUBES

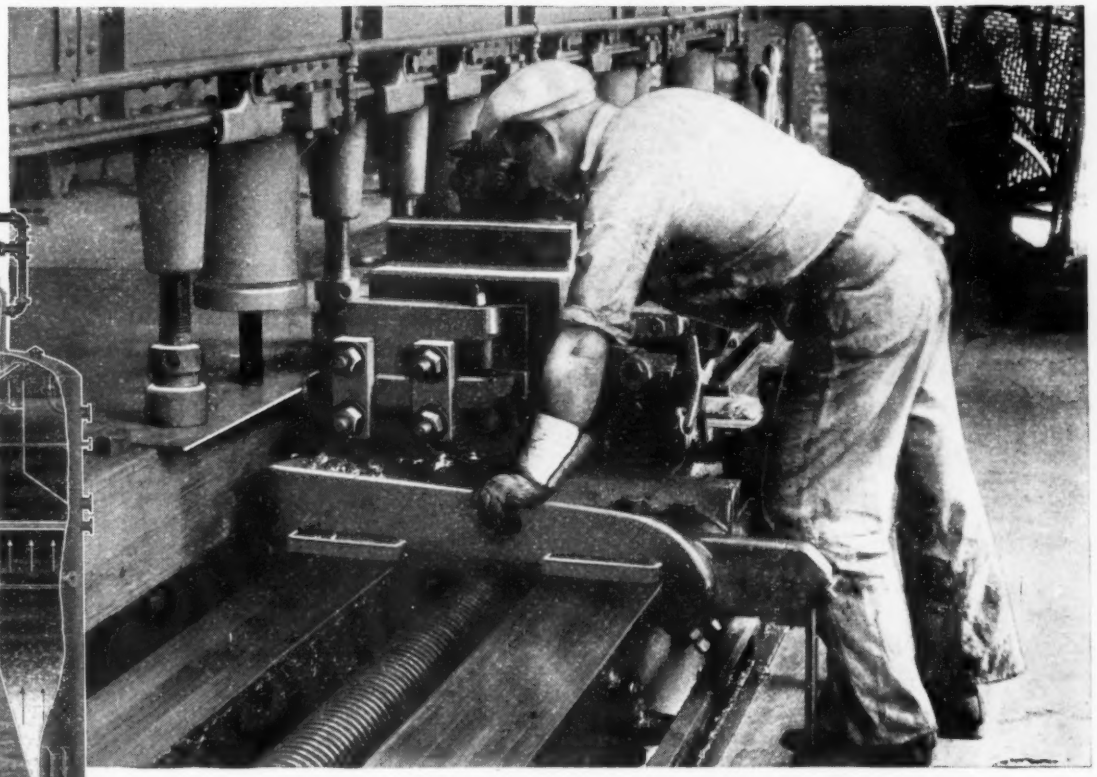
GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

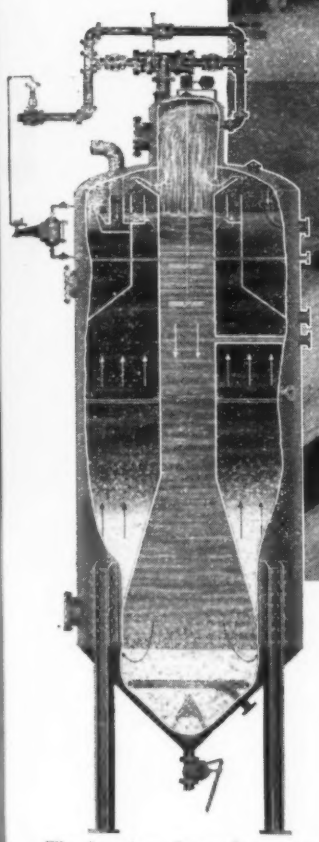
**GLOBE STEEL** *Tubes*

**GLOBE STEEL TUBES CO., *Milwaukee, Wisconsin, U.S.A.***

# WE'RE *helping to keep hundreds of plants rolling!*



*Planing a steel plate in preparation for welding*



The drawing above shows a cross-section view of the Graver Hot Process Water Softener with Deaerating Equipment. Like all Graver Water Conditioning Equipment, it can be built in any size to meet your specific requirements.

THE POWER PLANT is the heart of industry. To maintain production schedules, it must be kept at peak efficiency without interruption. Time out for boiler tube cleaning or repairs means a drop in production . . . idle manpower . . . and extra expense.

In hundreds of industries, Graver Hot Process Water Conditioning equipment is preventing such delays by supplying properly conditioned boiler feed water to the steam generating plant. This equipment softens raw water make-up and deaerates make-up water and condensate returns. It reduces hardness, thus eliminating scale-forming solids, and prevents corrosion by eliminating free carbon dioxide. It is power insurance . . . as essential to postwar progress as it is to today's war effort.

Whether yours is a need for today or merely a plan for the future, consult Graver . . . now. Our engineers will gladly discuss your problems with you and submit recommendations and estimates without obligation.

GRAVER

WATER CONDITIONING EQUIPMENT

43-50-W

*Water Conditioning Division of*

**GRAVER TANK & MFG. CO., INC.**

**4809-25 Tod Ave., East Chicago, Ind.**

NEW YORK CATASAUQUA, PA. CHICAGO TULSA

**Hot Process Water Softeners • Zeolite Water Softeners • Water Filters**
**Oil Removal Filters • Taste and Odor Removal Filters • Chemical Proportioning Equipment • Filtering Material • Reactivators**

# CLEANER LUBRICATING OIL *to withstand* HEAVIER WAR-TIME LOADS

Turbines and Diesel engines working long hours under full load need all the protection that high-grade lubricants can give. But even the best oil cannot give this protection unless it is continuously kept free from all the various types of impurities with which oils inevitably become contaminated in service.

De Laval Oil Purifiers are used in outstanding power plants—a very high percentage of them—to keep oil clean, because they do a thoroughly dependable job in a most economical manner. They save oil, it's true; but, what is more important these days and every day, they save prime movers, keeping them at work for longer periods and reducing maintenance cost.

There is a De Laval Oil Purifier and system for every size and type of power plant. Full details in Bulletin No. 106. In writing, please state your particular problem so that De Laval engineers can be of real help—without obligation, of course.

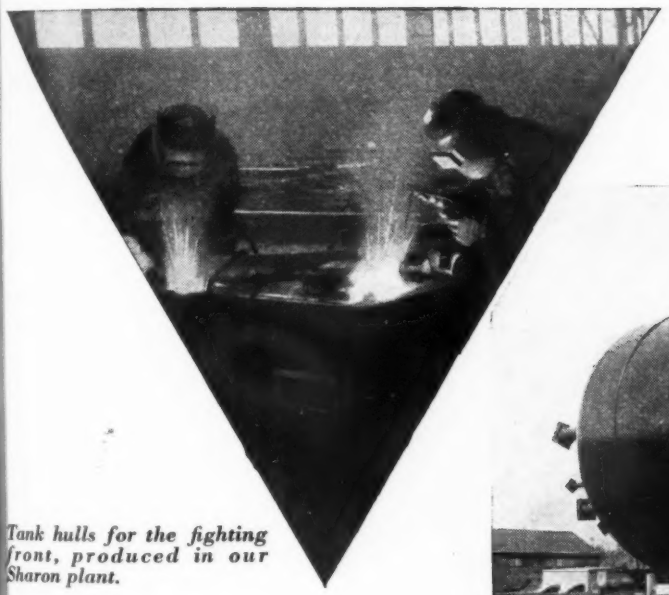
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 427 Randolph St., Chicago
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco
THE DE LAVAL COMPANY, Limited
Montreal Peterborough Winnipeg Vancouver

**DE LAVAL** *OIL PURIFIERS*

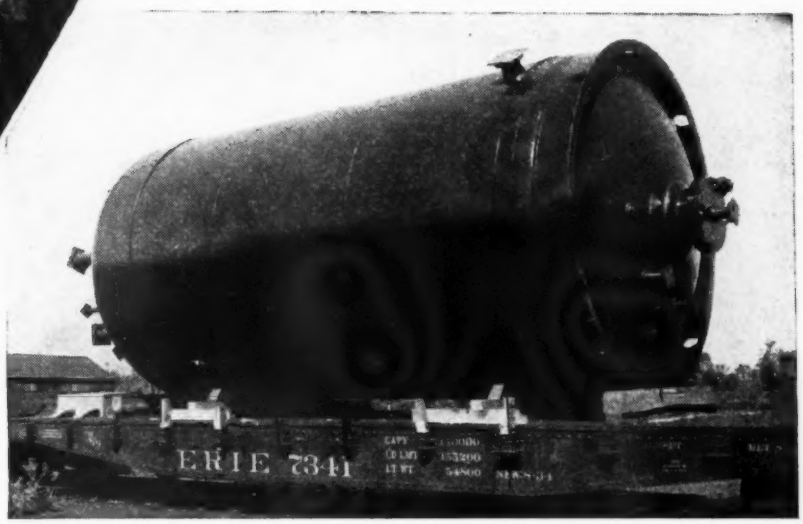
# BUILDING TOMORROW'S "KNOW-HOW"

Here in the General American Plate & Welding division plant at Sharon, Pennsylvania, men weld the armored hull of General Sherman tank. It's one of the best tanks in the world; everything that goes into it must be thoroughly *right*—so its makers place their confidence in GATX, as do industrial leaders in hundreds of widely different lines.

The most important thing we're producing now at Sharon and other GATX plants is *know-how*—vastly augmented experience, gained from geared-up wartime production, that will enable us to better serve YOUR peacetime needs.



*Tank hulls for the fighting front, produced in our Sharon plant.*




*Pressure vessels for the industrial front, produced at our Sharon plant.*

*Building for today's fighters—Planning for tomorrow's builders*

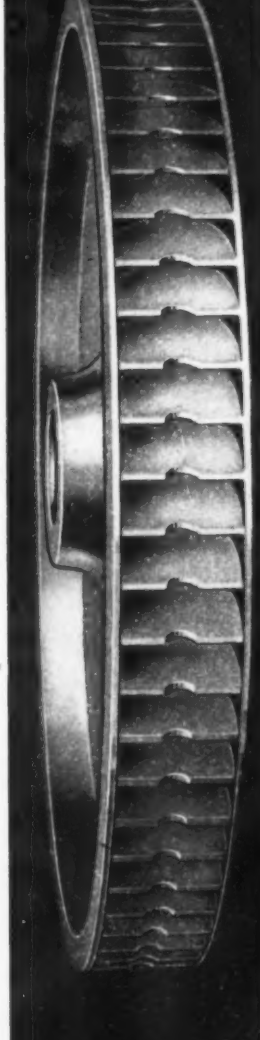
## GENERAL AMERICAN TRANSPORTATION CORPORATION

GATX GENERAL AMERICAN PLATE & WELDING DIVISION PLANT AT SHARON, PA.

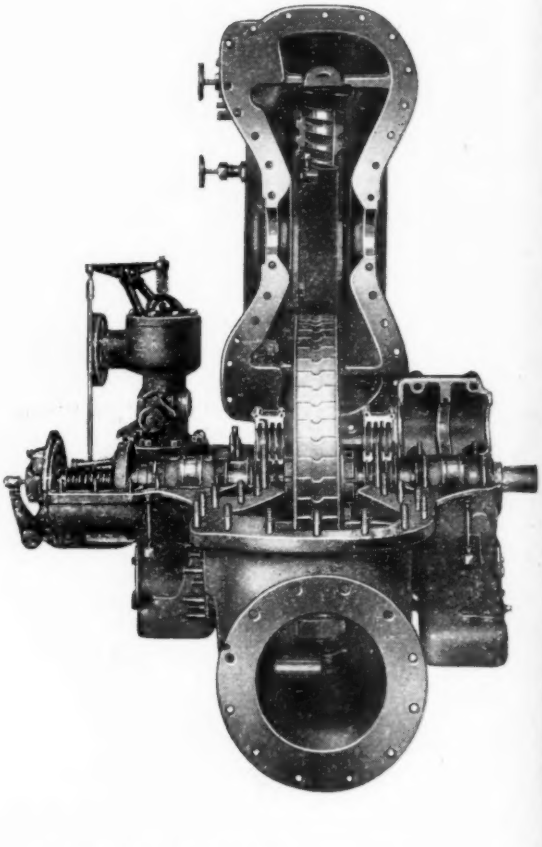
Plate & Welding Division — Sharon, Pennsylvania

"Specialists in plate fabrication—manufacturers of pressure vessels of steel, alloys and aluminum—all classes of welding—process equipment of all types—chemical engineering laboratories and service—completely equipped field erection department."

# TERRY



## SOLID WHEEL TURBINES are DOUBLE-RIM PROTECTED



In Terry Wheel Turbines the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

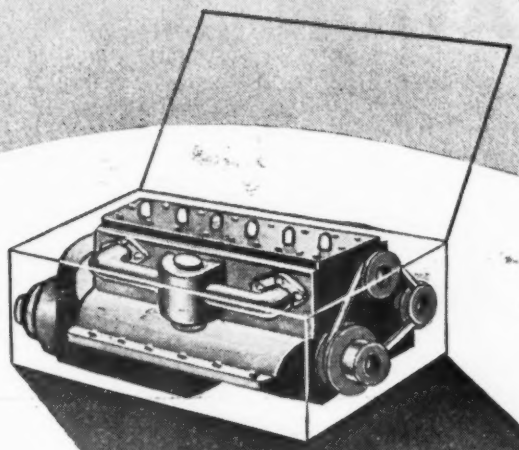
This and many other features of Terry wheel turbine design are fully described in our bulletin S-116. A request on your business letterhead will bring a copy.

**Above:**
**Typical Terry Wheel Turbine with cover raised. Unit is rated 400 HP at 3500 RPM with steam conditions of 650 lbs.— 825°TT — 2 lbs.**

T-1140

## THE TERRY STEAM TURBINE COMPANY
## TERRY SQUARE, HARTFORD, CONN.

*Flori "Pipe" Dreams of Tomorrow:*



# AUTOMOBILE ENGINES —CIGAR-BOX SIZE?

Who knows? The car of the future "dreamed up" by modern designers promises startling changes. Perhaps some day your car will be driven by a tiny hi-octane engine no larger than a cigar box—for longer wear at less cost.

To produce the millions of new cars American civilians are waiting for requires miles and miles of fabricated piping . . . that is our job.

**Include in your post-war planning**

## FLORI FABRICATED PIPING

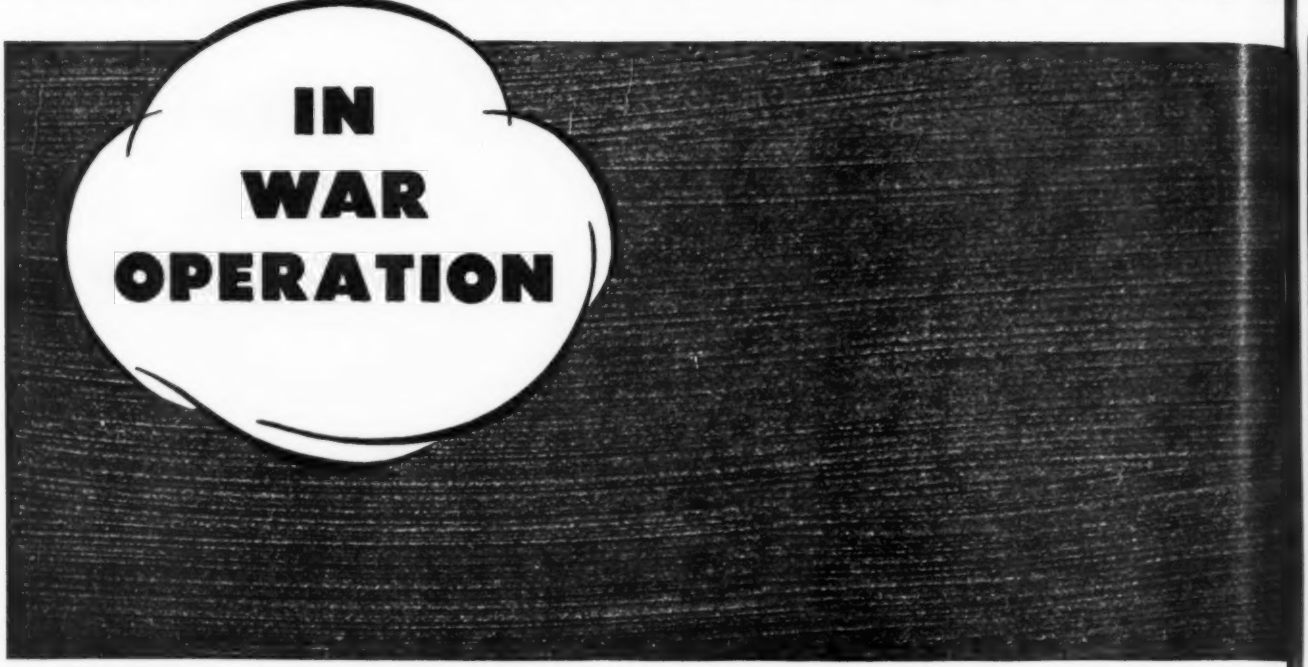
We make anything in tubular or plate steel fabrication: Fabricated Piping—for steam, water, air, oil, gas, chemicals. Random mill or cut lengths, bent, coiled, welded, flanged, threaded. Valves, Pipe Fittings.

**IF IT'S PIPING CONTACT FLORI**

FLORI PIPING

**THE FLORI PIPE COMPANY • ST. LOUIS—CHICAGO**

# The First Line of Defense




No matter how badly the steel mills need scrap, a turbine or boiler will aid the war effort more by staying on the job than by going on the scrap pile.

Inactive equipment . . . equipment nearing condemnation . . . often can be made to serve you for many more months and years when protected — the quick, easy, low-cost way — with APEXIOR. And new equipment can be preserved at peak condition by this essential maintenance and operating material.

### The Paint Takes the Wear

Hundreds of industrial power plants, utilities, railroads and marine operators have been using APEXIOR to lengthen the life of boiler or turbine metal. Applied with a hand brush or power-coater, APEXIOR seals up the pores and joints and provides a long-lasting, corrosion-resistant, scale-resistant covering for the metal. The APEXIOR takes the wear, not the metal — and one application lasts 2 to 3 years or more. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

APEXIOR is the safe, sure answer to lack of new equipment — the solution to your problem of getting more out of your present equipment. APEXIORIZE — you'll save valuable metal — and in the case of boilers, you'll lengthen periods between cleaning and make cleaning easier (with a wire brush).

**Users like these have applied APEXIOR for years. It will help YOU get more service from irreplaceable equipment.**

U. S. Army
U. S. Navy
U. S. Maritime Commission
U. S. Coast Guard
U. S. Bureau of Yards & Docks
U. S. Marine Corps
Cunard White Star, Ltd.
New York Central Railroad
Chicago & Northwestern Railroad
Georgia Power Co.
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Narragansett Electric Co.
Commonwealth Edison Co.

●

**Ease of Applying APEXIOR Explained — Cleaning Simplified**

Write, today, for Bulletin 1290 (Industrial) or 1305 (Marine) telling how to get peak production with peak protection.

APEXIOR

*A Peacetime Plus ★ ★ ★ A Wartime Must*

**RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES**

*The* **DAMPNEY COMPANY of America**
*protective coatings for*
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park, Mass.

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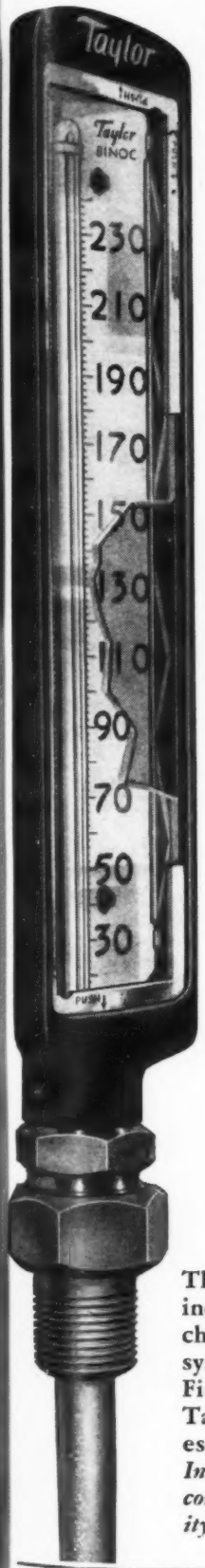
# Have you seen Taylor's NEW Industrial Thermometer?




1. **THE ONE-PIECE CASE** is practically fumeproof. Nothing to work loose. Shallower case makes easier reading through a wider angle of vision.

2. **INTERLOCKING BEZEL,** chromium-plated to resist corrosion, holds thick protective glass front against four wavy tension springs. The case itself is grooved to hold bezel in place securely.

3. **TENSION SPRINGS** are held in position by spring plates fastened under the scale by shakeproof screws. A rigid construction—rattleproof—dustproof. Ideal construction to withstand vibration.

4. **CLEAR THICK GLASS** is used on all Taylor Industrial Thermometers to give maximum legibility and maximum protection to the thermometer tube.

5. **EASY READING BINOC TUBE . . .** All Taylor Thermometers with ranges up to 750°F. are equipped with triple-lens Binoc tubing which is now better than ever. The mercury column stands out vividly through a wide angle of vision. Binoc is a patented feature, exclusive with Taylor Instruments. Easy reading Binoc invites frequent reading.

6. **BOLD, EASY READING SCALE** stands out clearly against a sharply contrasting background.

7. **MANY STANDARD RANGES** within the limits of minus 40° and plus 950°F.

8. **WIDE VARIETY** of stem constructions available.

9. **PERMANENT TAYLOR ACCURACY . . .** Glass tubes are heat treated to remove strain, which greatly reduces breakage—and artificially aged to prevent calibration change later. Tubing has sufficient test points to assure accuracy over entire range. Scale is *individually graduated* for each tube.

These thermometers are not only used independently but also serve as a basic check on accuracy of bimetallic or tube system thermometers. Ask your Taylor Field Engineer for full information. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY E NAVY

*Taylor Instruments*

MEAN

**ACCURACY FIRST**

IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★

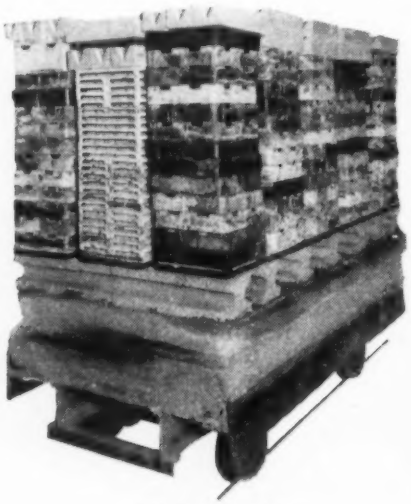
# It is practical experience that counts in applying Super Refractories

IN firing steatite—roasting corrosive ores—treating metal parts—reducing and refining non-ferrous metals, radically different conditions are encountered. Yet, in these diverse operations there is a common need—the need for super refractories such as produced by Carborundum. With the variable conditions existing in these as well as numerous other types of installations, no one grade or kind of super refractory is capable of meeting their individual requirements.

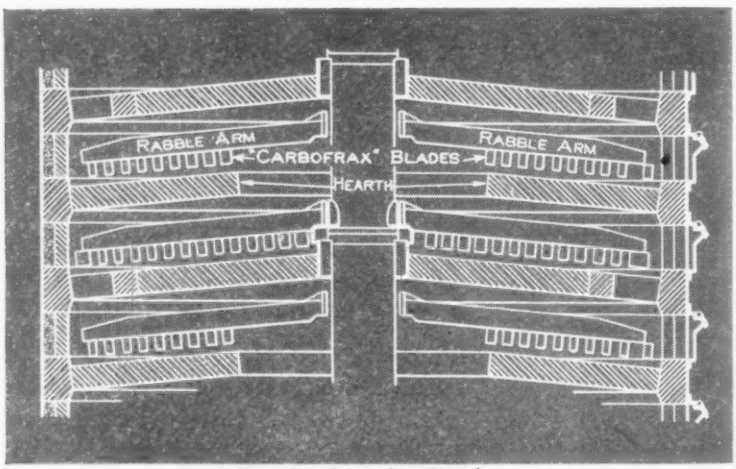
There are now more than sixty-five varieties of Carborundum Brand Super Refractories, each designed to withstand specific service needs. But of equal importance is the ability of our engineering staff to select the right super refractory for the purpose and apply it to a given installation.

Our comprehensive understanding of refractory problems—gained from years of practical and technical experience—has proved exceptionally valuable to war industry plants. It will be equally advantageous to operators of new and improved processes for the post war era.

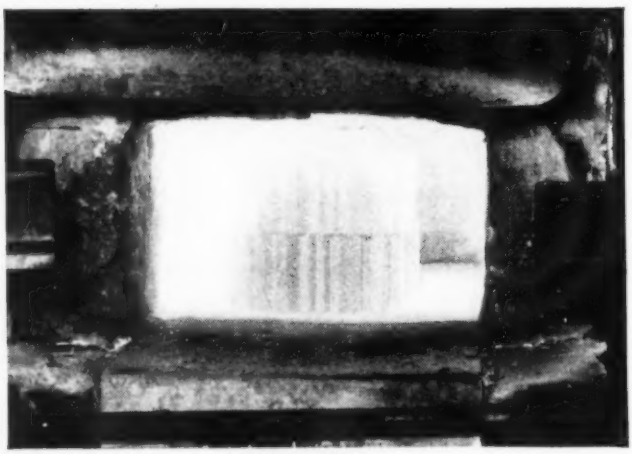
Let us consult with you on your refractory problems.



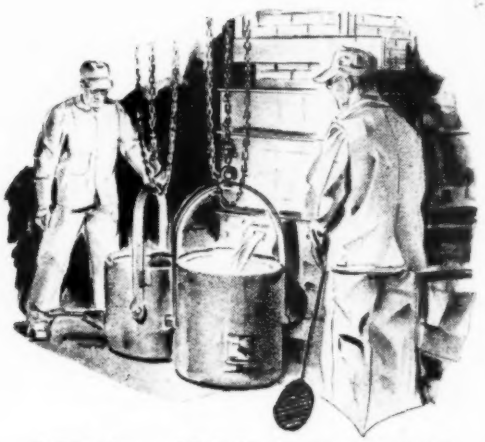
1 Firing Steatite




2 Roasting Corrosive Ores



3 Annealing



4 Reducing and Refining Non-ferrous Metals

*Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly!*

REFRACTORY CARBORUNDUM PRODUCTS
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*Refractory Division,* **THE CARBORUNDUM COMPANY,** *Perth Amboy, N. J.*

MANUFACTURERS OF GRINDING WHEELS, COATED ABRASIVES, SUPER REFRACTORIES, HEATING ELEMENTS

District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Firebrick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fire Clay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

(Carborundum, Carbofrax, Alfrax and Mullfrax are registered trade-marks of and indicate manufacture by The Carborundum Company)

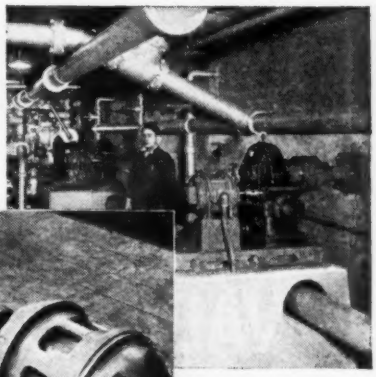
# WE CERTAINLY MAKE A LOT OF DIFFERENT TYPES OF SPEED REDUCERS..

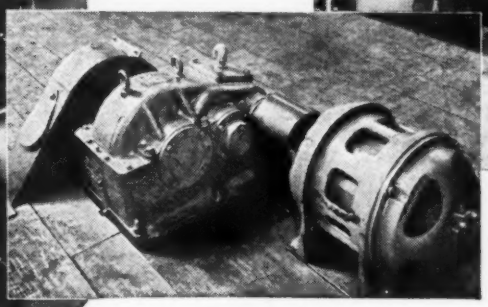
## YES, THAT'S WHY WE CAN SUPPLY A DRIVE FOR EVERY NEED!

Long ago, experience showed that the many industrial drive applications could be filled best only from a full line of speed reducing units—therefore we designed and make all types and sizes. Furthermore, each unit is tailored to fit the service. In that way Philadelphia Speed Reducers transmit power efficiently and economically to all kinds of equipment and give years and years of trouble-free service.

Where a self-contained drive is indicated, we recommend the vertical or horizontal MotoReduceR.

*Tell us your requirements and get our unbiased recommendations on the right type drive for your needs*





Shown here are 2 Philadelphia Speed Reducer installations.

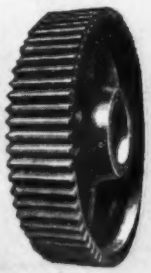
ARMY NAVY

# PHILADELPHIA GEAR WORKS, INC.

INDUSTRIAL GEARS AND SPEED REDUCERS — LIMITORQUE VALVE CONTROLS

ERIE AVENUE & G STREET
PHILADELPHIA 34, PENNA.
NEW YORK, PITTSBURGH, CHICAGO

**Philadelphia LIMITORQUE CONTROL** operates all types of valves, etc., safely, economically, from convenient stations.



**Philadelphia GEARS** All types and sizes of industrial gears. Can be supplied in all materials.

**Philadelphia HERRINGBONE SPEED REDUCER** for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

**Philadelphia MOTOREDUCER** The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

**Philadelphia WORM GEAR SPEED REDUCER** right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

*Darling Valve & Manufacturing Co. is more than 40 years old in experience but is modern in facilities. It can serve you best by solving your problems and recommending valves that last longer.*

# WANTED! THE TOUGHEST VALVE JOB YOU'VE GOT

● In every plant there is at least one "impossible" valve problem — that's the one we want! No matter what it involves—corrosive or erosive materials — high or low pressures or temperatures — mechanical operation to accurate timing — special alloys — unusual installations—severe operating conditions — where other valves have failed, have cost too much, have caused you trouble — *that's* the place Darling Gate Valve design can positively prove its value.

At your service are the engineers of the Darling Valve & Manufacturing Co. Working with actual field problems for over 40 years, this staff has met and solved almost every possible type of valve problem—perhaps the very one you are faced with now. Their service is yours without cost or obligation. Write or call the Darling Valve & Manufacturing Co., Williamsport, Pa.

**Darling offers you a quality line of longer-lasting Gate Valves. They come in Fully Revolving Double Disc Parallel Seat, also in Taper Seat—Slotted and Solid Wedge types. In service pressures up to 3000 pounds, you can get Darling Gate Valves in Cast Iron, Bronze, Forged Steel, Cast Steel, and Corrosion Resistant Alloys. Darling also manufactures Compression Type Fire Hydrants, Check Valves, Motor and Cylinder Operated Valves, and many accessories.**

TRADE DARLING MARK

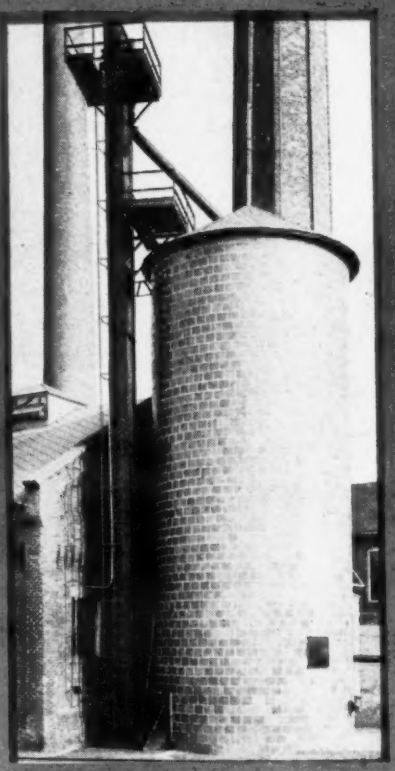
**VALVE & MANUFACTURING CO.**

WILLIAMSPORT, PA.

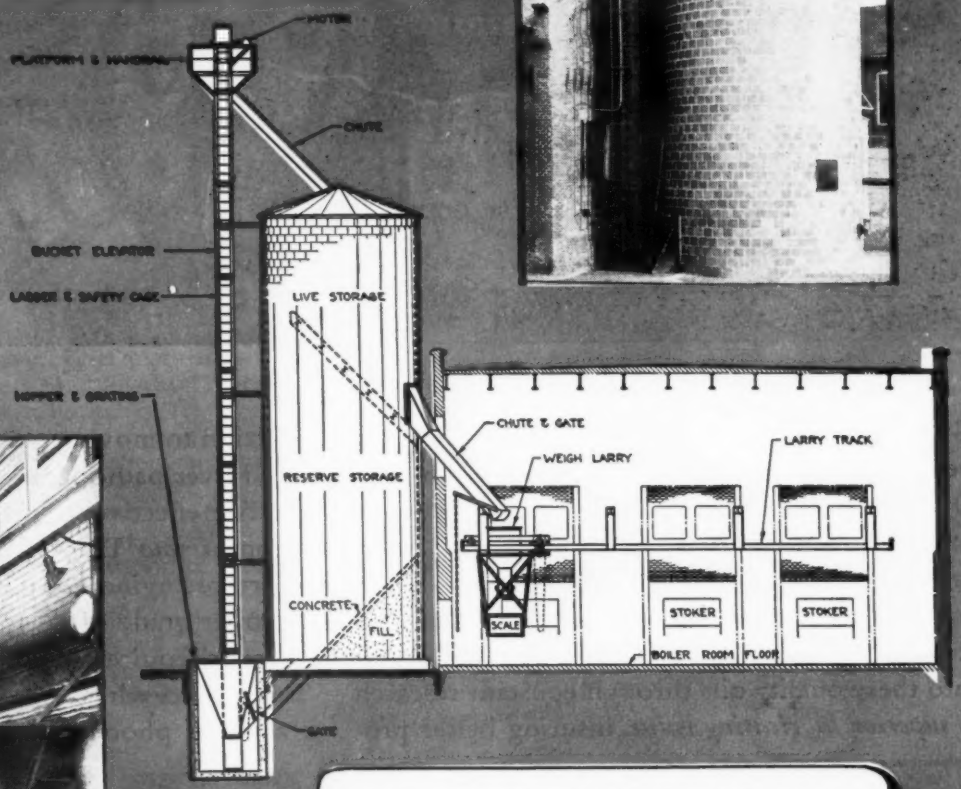
## For Efficient – Clean – Boiler Room Operation
## Use this modern method

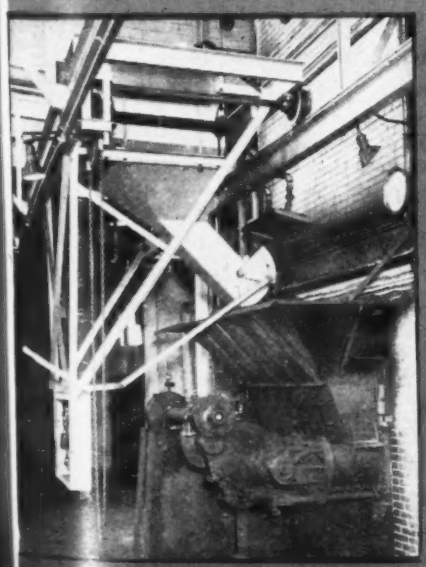
# FAIRFIELD
# SILO SYSTEM

Note how Silo is built outside boiler house . . . no building changes necessary . . . a most efficient and economical method of storing and handling coal . . . easily adapted to plants requiring 200 to 1000 tons storage . . . built of vitrified tile . . . will not absorb moisture . . . wall construction also insulates against freezing . . . elevating equipment generally used, skip hoist or bucket elevator . . . conveying system to boilers either Screw Conveyors or Weigh Larries.



**FAIRFIELD** provides a complete system for the handling and storage of coal—from car to stokers or pulverizers—all automatic.

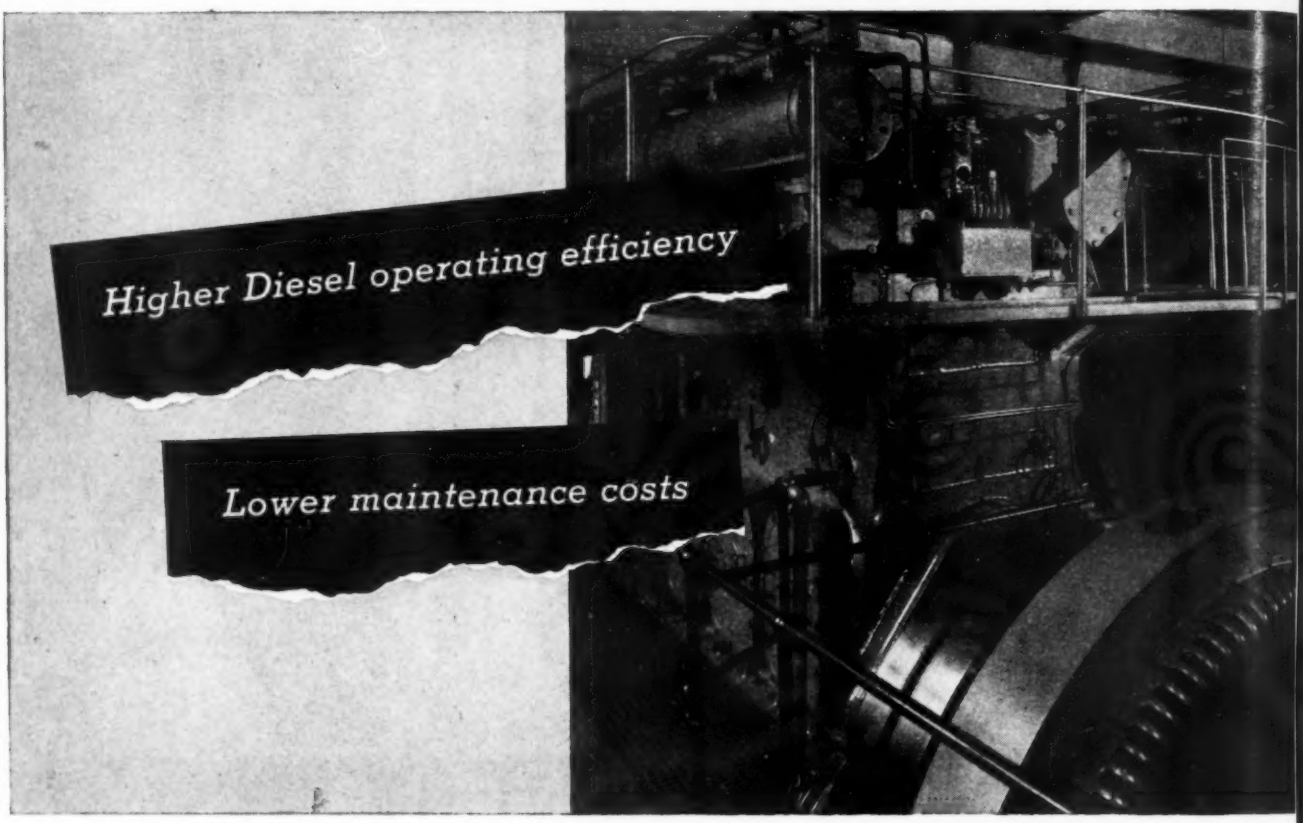


Write today for New Catalog, full of photographs and drawings of typical installations or ask one of our Engineers to call.

## THE FAIRFIELD ENGINEERING CO.- MARION, OHIO
BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

# Improved Lubrication with Gulf Parvis Oils pays dividends:




Gulf Parvis Oils are writing a list of definite benefits in the operating records of hundreds of Diesels. The list includes greater efficiency, lower maintenance costs, fewer shutdowns for repairs, and longer service life.

Here's the important reason for the outstanding performance of Gulf Parvis Oils: Built into these quality oils through constant research is *superior lubricating value*, insuring better protection to moving parts under today's peak load and overload operating conditions.

For effective help in improving the lubrication of *your* Diesels, call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade of Gulf Parvis Oil to fit your particular requirements. He has had broad practical experience with all types of Diesel engines. Write, wire, or phone your nearest Gulf office today.

**Gulf Oil Corporation · Gulf Refining Company**

**Gulf Building, Pittsburgh, Pa.**

GULF INDUSTRIAL LUBRICATION

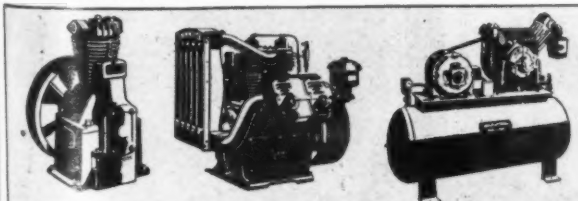
It will pay you to investigate—call in a Gulf Lubrication Service Engineer

## *Get the inside facts and you'll see why Industry prefers Worthington "Feather* Valve" Compressors over other makes*

Huskier, *heavier* — 30 to 300% heavier, size for size, price for price — all Worthington "Feather* Valve" Verticals have the same rugged qualities as the big Worthington Air Compressors. "Feather* Valve" Radials have such special service-stretching features as airplane-type connecting rods and non-stop forced-feed lubrication. And both types have the famous trouble-free "Feather* Valve".

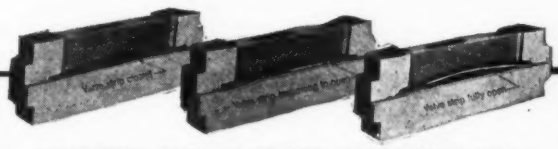
You may need air power for any one of a hundred uses, but this much is sure: the extra weight, the better valves, the more efficient lubrication of Worthington "Feather* Valve" Compressors can save you downtime, maintenance costs, and add years to compressor life in your plant. Investigate, call our nearest District Office or Authorized Industrial Dealer. You, too, will get *more* air, more *worth,* from air — with Worthington!

*REG. U. S. PAT. OFF.



**Vertical and Radial Air Compressors,** in hundreds of combinations from 20 to 2000 lbs. pressure, delivering 1 to 360 c.f.m. — in mountings to suit all jobs — Industry's first choice.

AC 4-2



**"FEATHER* VALVE" MAKES BREATHING EASY**

The "Feather* Valve" is the lightest, most efficient valve in use, simple in construction and operation . . . opens and closes by easy flexing . . . too light to develop destructive inertia . . . too flexible to warp. Simple . . . Foolproof . . . Dependable . . . Assures satisfying service and performance plus.

*Standard Products Division*

**WORTHINGTON PUMP AND MACHINERY CORPORATION**
**Harrison, New Jersey**

YOUR MONEY'S WORTH
**WORTHINGTON**

*Ten Real Reasons Why*

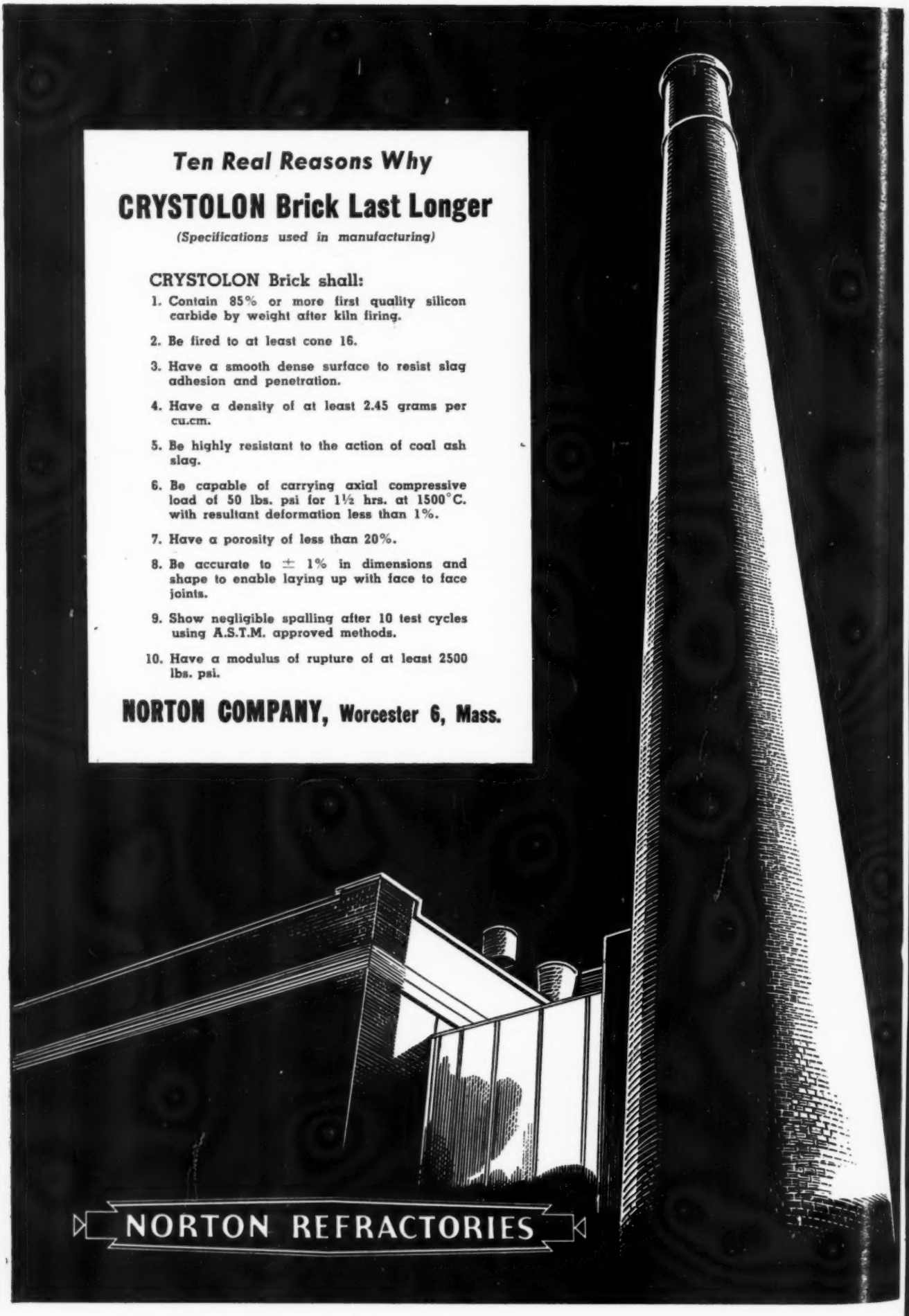
# CRYSTOLON Brick Last Longer

*(Specifications used in manufacturing)*

CRYSTOLON Brick shall:

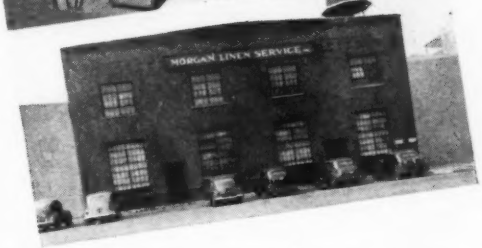
1. Contain 85% or more first quality silicon carbide by weight after kiln firing.
2. Be fired to at least cone 16.
3. Have a smooth dense surface to resist slag adhesion and penetration.
4. Have a density of at least 2.45 grams per cu.cm.
5. Be highly resistant to the action of coal ash slag.
6. Be capable of carrying axial compressive load of 50 lbs. psi for 1½ hrs. at 1500°C. with resultant deformation less than 1%.
7. Have a porosity of less than 20%.
8. Be accurate to ± 1% in dimensions and shape to enable laying up with face to face joints.
9. Show negligible spalling after 10 test cycles using A.S.T.M. approved methods.
10. Have a modulus of rupture of at least 2500 lbs. psi.

**NORTON COMPANY, Worcester 6, Mass.**



NORTON REFRACTORIES

# For *Morgan Linen Service* Chicago




## 105.7 lbs. of cheap, low-grade coal for every 100 lbs. of laundry...

## *plus*

## Electric energy for all power and light requirements

● In laundry operation where volume is heavy and margins small, every fraction of a cent saved in production reflects itself in net profit. Keeping costs down is a mandate all along the line. At the Morgar Linen Service, Chicago, they're happy with their Bros Steam generating units equipped with Bros Super-Spred Stokers.

Mr. Dan Ponzetti, chief engineer of the plant, is authority for these figures based on a 60 hour plant run.

- . . . for every 105.7 lbs. of cheap, low-grade coal consumed, they turn out 100 lbs. of laundry, with a water consumption of 673 gallons—this is really getting costs down.
- . . . during this period 5,935 K.W.H. of electric energy was generated for all light and power requirements, remarkable when you consider that this is a plus value, over and above laundry production.
- . . . steam flow was 1,107,000 lbs. at a steam cost of 33-7/10c per 1000 lbs.
- . . . fuel, 10,790 B.T.U. Illinois Coal, with high ash and low fusion temperature.

The power load at the Morgan plant is heavy, and continuous. A Bros 500 h.p. water tube boiler with two Bros Super-Spred Stokers meet this steady load requirement with high efficiency. There is no special heat recovery apparatus. Equipment includes automatic combustion controls and instruments.

Bros brings to your power problems an undivided responsibility and single source of supply for boilers or fuel feeding equipment. Regardless of the load, light or heavy, continuous or widely fluctuating, and regardless of the kind or size of coal, the Bros Super-Spred Stoker does the job with highest possible efficiency. Detailed literature on Bros boilers and spreader stokers is available. Resident representatives serve all markets.

**WM. BROS BOILER & MFG. CO.**
**Minneapolis, Minnesota**

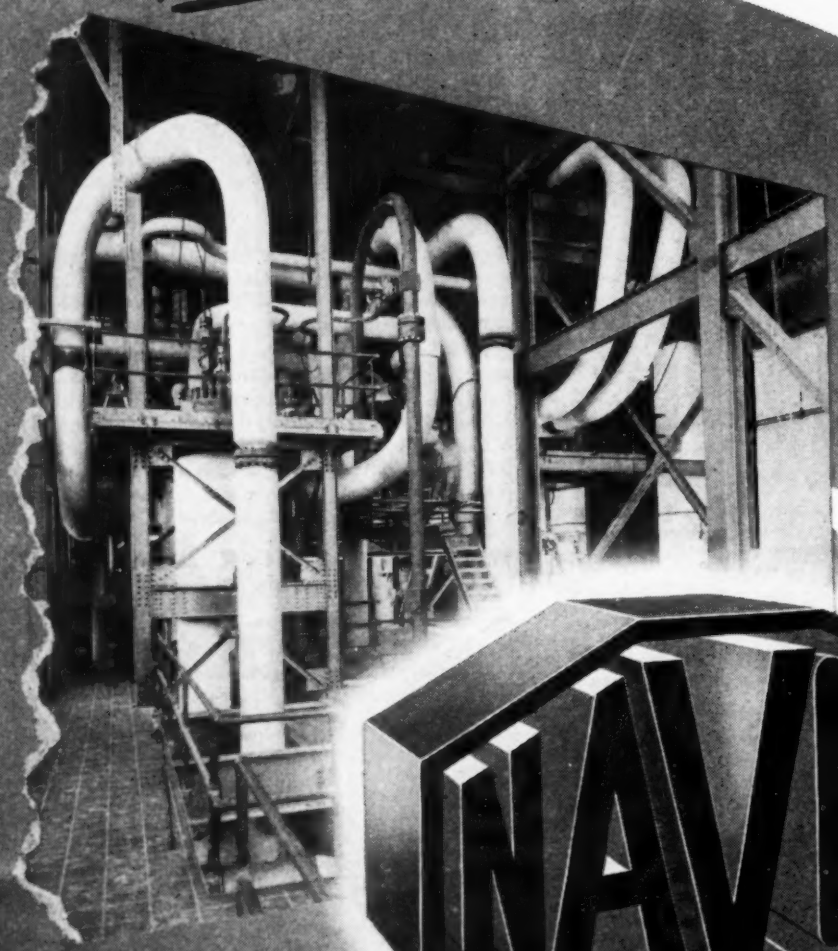
**BROS PERFORMANCE CHECK LIST**
**How does this compare with your present operation?**

| | Morgan Linen Service | Your Plant |
|---|---|---|
| **Low-Cost Laundry Output** | 100 lbs. of laundry for every 105.7 lbs. of coal burned. | |
| **Power and Light Plus Value** | 5,935 K.W.H. electrical energy generated in 60-hour run for all light and power requirements. | |
| **Cheap, Low Grade Coal Burned** | 10,790 B.T.U. Illinois coal with high ash, low fusion temperature—burned at good efficiency. | |

## STEAM GENERATING UNIT WITH

# BROS *Super-Spred* STOKER

# Today's Answer to *Power Piping Problems*



NAVCO

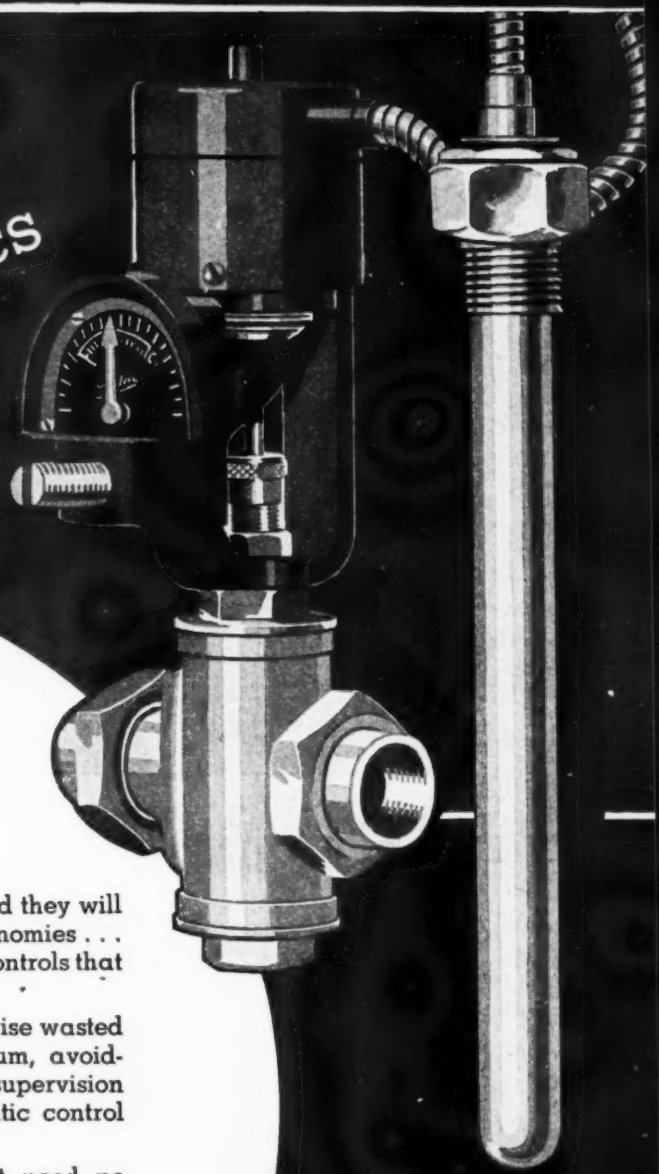
NAVCO PIPING

## NATIONAL VALVE & MANUFACTURING CO.

PITTSBURGH PENNSYLVANIA

# Controlling Process Temperatures

CHEMICALS
TEXTILES PETROLEUM
PAPER RUBBER STARCH
WOOD PRODUCTS PLASTICS
METALS VEGETABLE OILS



Sylphon TRADE MARK

**SELF-OPERATING**
## CONTROLS

They are vital in getting out the products of War. And they will be even more vital to post-war manufacturing economies . . . these self-contained, self-operating, efficient Sylphon Controls that guard temperatures in the heat-processing industries.

Helping to insure uniform quality, saving steam otherwise wasted through over-heating, reducing spoilage to a minimum, avoiding costly delays in production, reducing labor and supervision —these Controls offer all the advantages of automatic control at small "first cost."

They are simple, rugged, independent devices that need no highly skilled "instrument engineers" to install, adjust, repair and keep in operation—no wiring, piping or involved auxiliary equipment. They are literally "thermometer-operated valves" that automatically *modulate* processing temperatures at exact predetermined levels, day in and day out, for nothing, for life.

Why don't you join the long list of users of more than 250,000 Sylphon Regulators throughout Industry. Call in a Sylphon representative to discuss your temperature control problems or write for Catalog No.

ARMY E NAVY

"ONE OF THE SOUTH'S INDUSTRIAL PIONEERS"

**THE FULTON SYLPHON CO.**
KNOXVILLE, TENNESSEE

# Why the convoy got through—

It hasn't been long since the dark hours when a rescued war correspondent cabled that "everything seemed to favor the subs with only prayers left for the convoys."

But all that is changed now, and one of the reasons is these Destroyer Escorts — a new type of ship especially designed to protect convoys from the wolf packs and the hawks. The DE's are fast, comparable in length to destroyers, well-armed to slug it out, and have plenty of heavy plate to stay in and take it.

On the DE's, as on other fighting ships, landing craft, barges and planes, Marsh Pressure Gauges are out where the going is tough. Commonplace though they appear, no instrument plays a more important role in today's global drama.

For this vital assignment gauges must be built not only to *be* accurate but to *stay* accurate. It's an assignment that calls for the kind of painstaking construction which has distinguished Marsh instruments for more than three quarters of a century.

JAS. P. MARSH CORP., 2075 Southport Ave., Chicago 14, Ill.

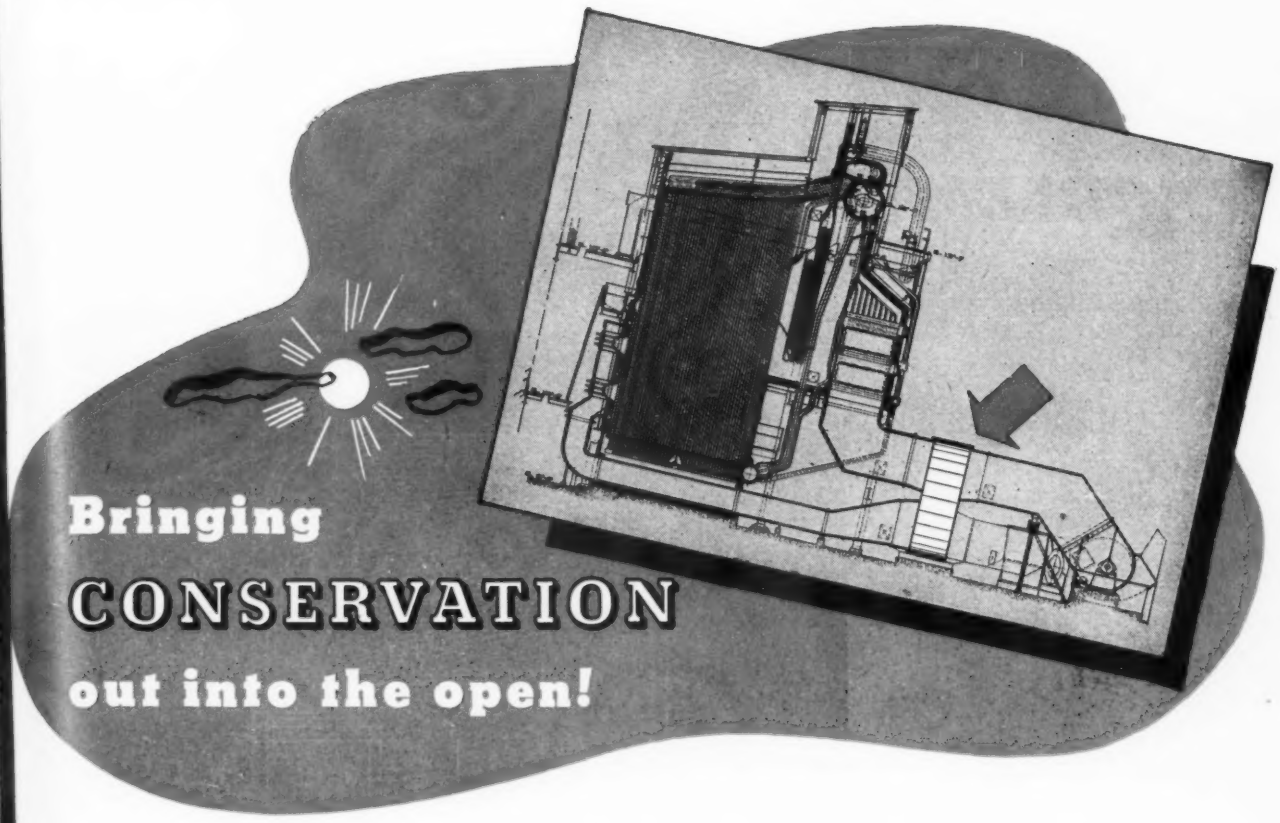
**The Gauge with the "RECALIBRATOR"**

A gauge built to Marsh Standards is not likely to be knocked out of adjustment. But if it is, the Marsh "Recalibrator" will quickly restore its accuracy. Simply turn the "Recalibrator" screw until the pointer is at zero when not under pressure. The gauge will then be right at all points on the dial. Unlike other methods of resetting, the "Recalibrator" gets at the root of the error —re-establishes the relation of the bourdon tube to the movement — actually recalibrates the gauge.

The "Recalibrator" is standard in the Marsh Mastergauge illustrated here, and is available in all Marsh Gauges, Dial Thermometers and Recorders.

# MARSH GAUGES

**DIAL THERMOMETERS ★ RECORDERS ★ HEATING SPECIALTIES**




## New Gulf Coast State Utility Plant of Outdoor Type Is Equipped with Ljungstrom Preheater

*Here's a boiler plant in which fuel savings are backed up by sound conservation of steel and other structural materials. Designed for natural gas firing, it has a maximum continuous rating of 425,000 lb steam per hr. Operating pressure is 900 lb per sq in. Gases enter the preheater at 775 deg F, leave at 370, and heat the combustion air to 632 degrees. Preheater and fan assembly are installed out in the open between the steam generator and stack.*

• • • • •

Ljungstrom Air Preheaters save fuel two ways. First, they recover heat that would otherwise be lost up the stack, increasing efficiency of the plant by 6 to 10 percent. Second, they provide more effective combustion conditions, a factor of particular importance in burning lean fuels. In some cases, preheating of combustion air makes it possible to use fuels that would otherwise be unsatisfactory.

At the same time, this compact *regenerative* type of preheater saves appreciably on steel and construction materials. First, because optimum heat recovery is obtained with *one-half* to *one-third* the weight of steel in the preheater itself, as compared to other types. Second, because lower weight and compact design permits a simple supporting structure.

Today, the *conservation* features of the Ljungstrom are expanding its application from high-efficiency boiler plants to a wide range of industrial applications where gas-to-air heat transfer can save fuel and improve combustion. These applications include oil heaters, metallurgical furnaces, and the like.

For the complete story on the operating principle and construction features of the Ljungstrom Air Preheater, write for a copy of Bulletin S-1.

*For* **PRODUCTION ACHIEVEMENT . . .**

The U. S. Maritime Commission has awarded its "M" Pennant and Victory Fleet Flag to the men and women of Air Preheater Corporation.

**THE**

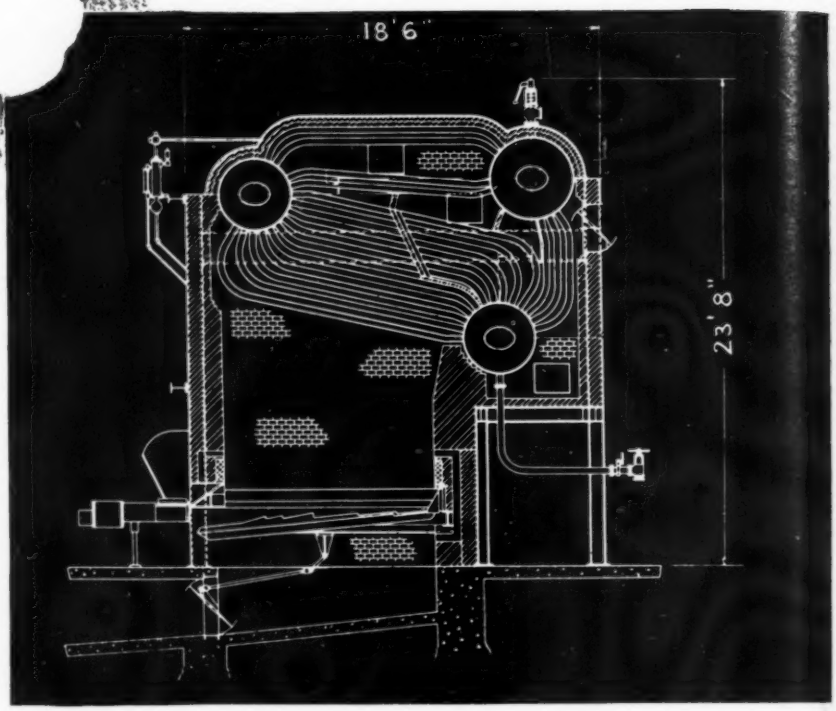
# AIR PREHEATER

**CORPORATION**

**Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York**

## PROBLEM:

To increase steam output despite low head room.




Installation of Edge Moor Low Head Boiler.

## SOLUTION:

To provide increased steam requirements, a paint and varnish plant installed a 285 hp Edge Moor Low Head Water Tube Boiler. This three drum unit went into virtually the same space formerly required for two 80 hp boilers. This installation has delivered up to 12,000 lbs. of steam per hour at 8 to 10 lbs. pressure.

To meet the requirements of moderate capacities and rapid change in loads, four series of Edge Moor Low Head Boilers are offered in a range of sizes from 100 to 600 hp and for any working pressure up to 900 pounds, for use with any type fuel.

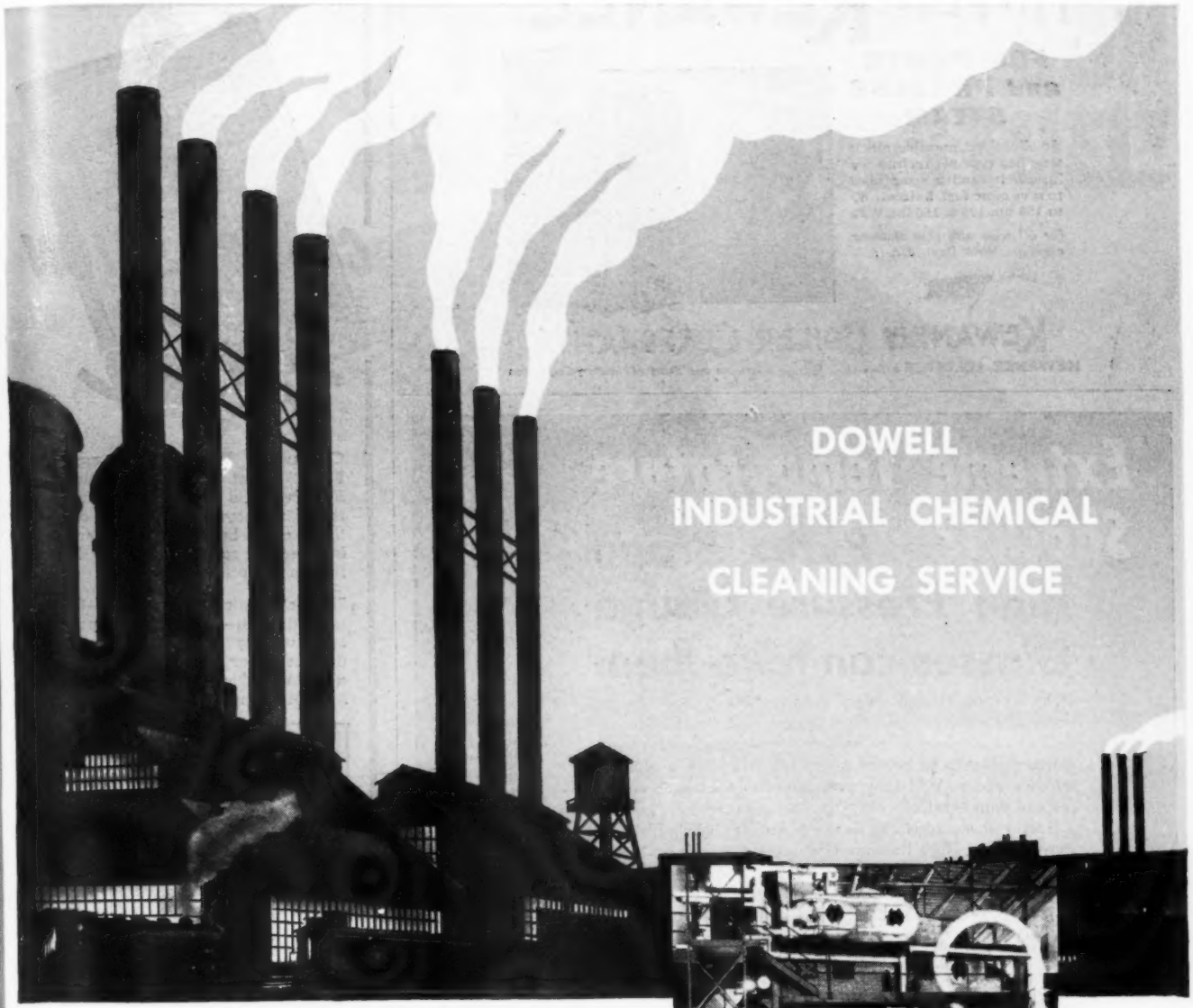
Many other Edge Moor boilers—in a wide range of types, capacities, pressures and accessory equipment—are available. Send us details covering your requirements for prompt quotation. Write!

**STEAM GENERATING EQUIPMENT**

*BRANCH OFFICES:* NEW YORK CITY: 30 ROCKEFELLER PLAZA
CHICAGO: ONE NORTH LA SALLE STREET

**EDGE MOOR IRON WORKS, INC.**

*MAIN OFFICE:* EDGE MOOR, DELAWARE




# MAKES POSSIBLE GREATER FUEL ECONOMY

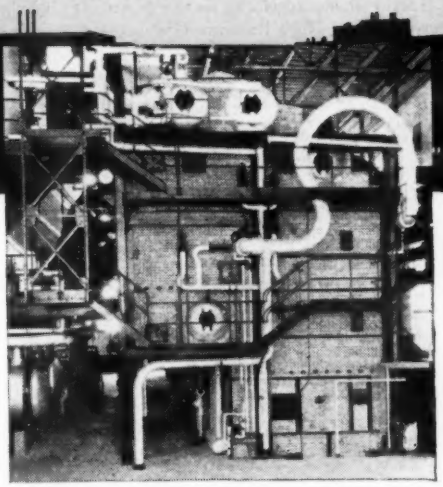
Ever since water was first used as a heat transfer medium, the steam or water-deposited scales and sludges have presented a serious industrial problem. Today, through the application of chemistry, Dowell removes these deposits from heat exchange surfaces in a few hours' time without dismantling the equipment. Important savings in fuel result—down-time is cut to a minimum—efficiency is improved—heat transfer is faster.

The service employs mobile equipment, chemical solutions and trained personnel. It is designed to quickly dissolve and disintegrate most scale and sludge deposits.

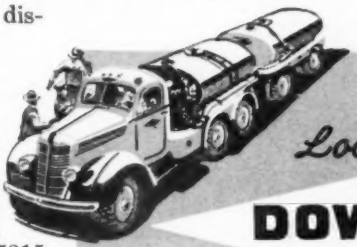
This pioneer chemical service is successful in cleaning many types and all sizes of industrial boilers, cooling jackets, economizers, condensers, feedwater heaters and water lines.

For details write or contact Dowell office in your locality. New York, 30 Rockefeller Plaza; Philadelphia, Girard Trust Bldg.; Cleveland, 2314 Terminal Tower Bldg.; Chicago, 135 So. LaSalle; St. Louis, 2nd and Madison; Houston, 5315 Lawndale Ave.; Kansas City, 3560 Broadway; Wichita, Union National Bank Bldg.; Mt. Pleasant, Mich.; Salem, Ill.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company



*Complete removal of water-deposited scale and sludge from a 1000 HP Steam Generator, such as the one pictured here, was accomplished in less than 24 hours with Dowell Industrial Chemical Cleaning Service.*



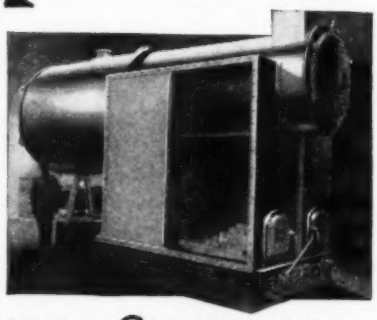
*Look to*
**DOWELL**
FOR INDUSTRIAL CLEANING AND SCALE REMOVAL SERVICE

# HI-TEST KEWANEE

**FOR POWER and PROCESS STEAM**

An all-welded, portable, quick steaming type with refractory linedfirebox andtwo-passtubes to save more fuel. 6 sizes...50 to 150 hp. 125 & 150 lbs. WP.

*For 6" scale with pipe diameter markings, Write Dept. KK-1.*



KEWANEE BOILER CORPORATION

KEWANEE, ILLINOIS • Division of AMERICAN Radiator and "Standard" Sanitary Corporation



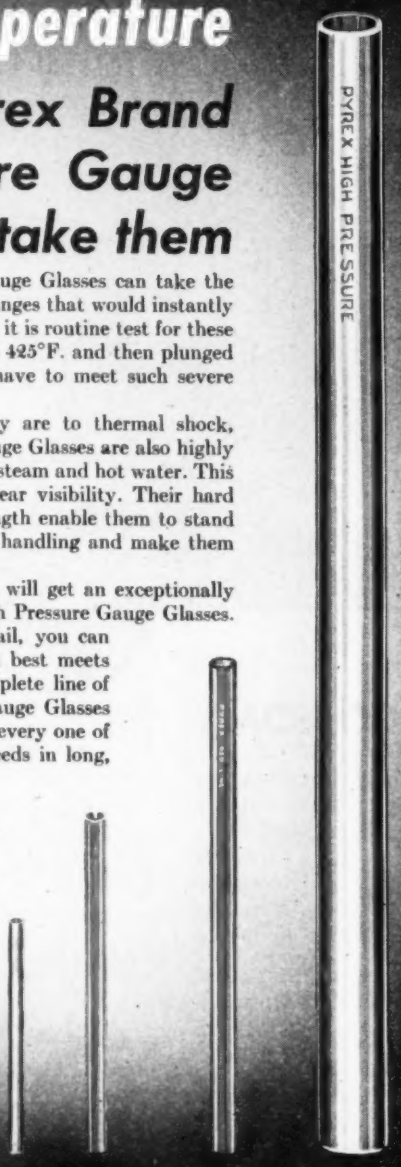
# Extreme Temperature Shocks? Pyrex Brand High Pressure Gauge Glasses can take them

PYREX brand High Pressure Gauge Glasses can take the shock of sudden temperature changes that would instantly shatter an ordinary glass. In fact it is routine test for these gauge glasses to be heated up to 425°F. and then plunged into ice water. Will they ever have to meet such severe tests in your service?

And just as resistant as they are to thermal shock, PYREX brand High Pressure Gauge Glasses are also highly resistive to the solvent action of steam and hot water. This means that they retain their clear visibility. Their hard smooth surface and rugged strength enable them to stand up better under rough physical handling and make them less liable to become scratched.

Yes, you can expect and you will get an exceptionally long life from PYREX brand High Pressure Gauge Glasses.

Where other conditions prevail, you can select the right gauge glass that best meets your requirements from the complete line of PYREX and CORNING brand Gauge Glasses listed below. You will find that every one of them will fill your particular needs in long, value-giving service.




PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

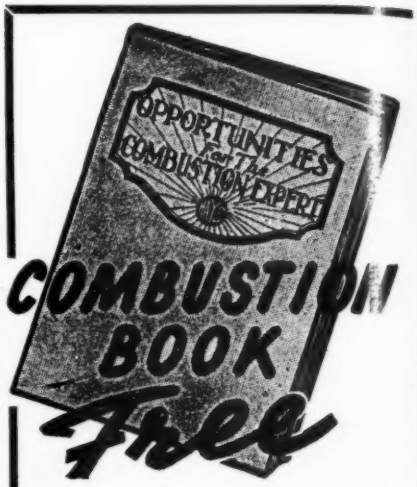
CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

*"Pyrex" and "Corning" are registered trade-marks and indicate manufacture by Corning Glass Works.*

CORNING Glass Works Corning, New York

**Pyrex Gauge Glasses**






**Combustion Efficiency as applied to Boiler Plant Operation, Fuels and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.**

**The Combustion trained man—the Hays trained man—can do his part, and open up big opportunities for himself that never existed before, by devoting a little of his spare time in training himself to meet present conditions.**

***Just a Few of Our Hundreds of Friends***

International Harvester Co..20
Armour and Co.75
Combustion Engineering Company .....45
Riley Stoker Corp. .....75
Iron Fireman Mfg. Co.....35
Commonwealth Edison Company .....145
State of Illinois.85
Cities Service (Oil & Power) 70
and many others.

**How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.**

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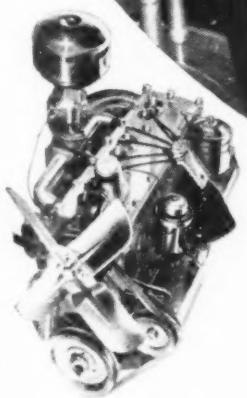
# RING-FREE REMOVES CARBON REDUCES FRICTION, SAVES FUEL!

## Don't Deprive *Any* Power Plant Of This Operating Economy!



Carbon trouble is expensive in down-time and repair bills on all sizes and types of Diesel and Gasoline engines. In every engine suffering from carbon, the first crankcase full of Macmillan RING-FREE Motor Oil begins to *remove* the carbon from pistons, rings, valves *while the engine runs.* Continued use of RING-FREE keeps the formation of destructive carbon in check. The result is a cleaner, more thoroughly lubricated, sweeter running engine.

Another, even greater RING-FREE advantage is its ability to reduce friction *fast!* That actually delivers more power to the drive shaft . . . produces measurable fuel savings. It also cuts down wear and repair. Many operators who started by lubricating just one of their engines with RING-FREE were so convinced by the performance and economy obtained that they now order Macmillan RING-FREE for *all* their motorized equipment.

MACMILLAN PETROLEUM CORPORATION

50 West 50th Street, New York 20 • 624 South Michigan Avenue, Chicago 5 • 530 West 6th Street, Los Angeles 14

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REDUCES WEAR BY REDUCING FRICTION

## *Regardless of the Mineral Content of Most Water*

The positive De-Scaler Action will remove scale in the boiler.

No chemicals required—No water analysis is necessary.

The Butler De-Scaler* creates a water in the boiler that is no longer hard, but through precipitation of the various mineral salts renders a pure water that causes all scale, already formed in a boiler, to soften over a short period of time and gradually fall to the bottom so that it may be easily washed away.

Having no moving parts, De-Scalers require no adjustment or daily attention.

De-Scalers keep inside of the boiler surfaces scale free and prevent foaming, pitting and corrosion.

The maximum of boiler protection is obtained with De-Scalers. They minimize repairs, retubing and long shut downs.

In thousands of boilers De-Scalers are providing the most economical means of water treatment ever devised. De-Scalers can be installed in any type of boiler in a few minutes, their action is immediate and they achieve the results you want.

**DEFINITE DE-SCALER PERFORMANCE.**

Regardless of the scale thickness, or type of incrustation De-Scalers will cause its removal particularly in the inaccessible parts of the boiler.

De-Scalers will prevent electrolytic and oxygen corrosion not only in the boiler alone but throughout the entire system.

When boilers become scale free they remain in that condition permanently as long as De-Scalers are used in accordance with instructions.

No water analysis necessary—stops scale formation—positively causes the removal of old scale—stops foaming and priming—prevents electrolytic and oxygen corrosion—will not harden soft packing—will not corrode metallic packing — eliminates hand scaling and tube turbining—will maintain a proper pH value—no long boiler shut down for cleaning—no chemicals or boiler compound needed. All De-Scalers used in accordance with our instructions will fulfill the above.

***Send for booklet "Presenting Butler De-Scalers"***

*BACK THE ATTACK WITH WAR BONDS*

*Patented; other patents pending. Trademark Reg. U. S. Patent Office

**BUTLER ENGINEERING CO.**

**926 Magazine Street** **New Orleans, 13, La., U. S. A.**

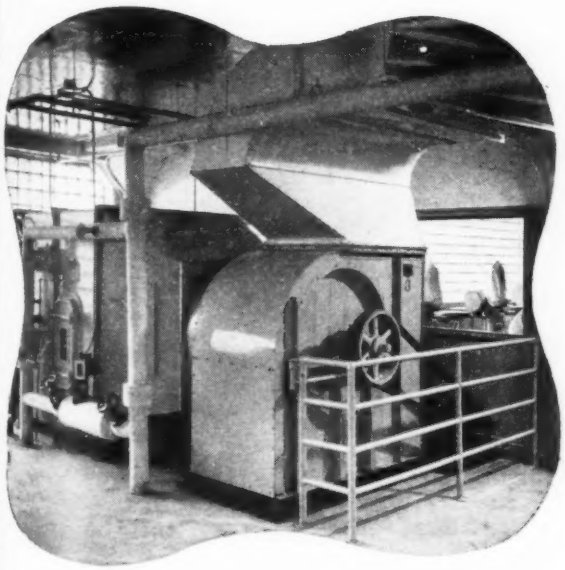
**Export Agents: Wm. McDonagh & Sons, 180 Front St., N. Y. 7, N. Y., U. S. A.**

***Distributors with stock and service in important industrial centers throughout the United States.***

# In order that more may *Live!*

★
BUY U.S.
WAR BONDS
★

## We are honored to play a part in producing PENICILLIN



"WOUNDED IN ACTION!" . . . But today, even in those cases of infection where Sulfa fails, there's a shining new hope for swift and complete recovery . . . thousands of our boys coming back *alive* because Penicillin is now available to the fighting forces.

Penicillin, as you may have read, is the product of mold which secretes tiny drops of this precious drug when nurtured on a special liquid diet.

The mold grows faster — secretes *more* Penicillin — when cultured under *constant* atmospheric conditions . . . and so air conditioning becomes a vital factor in the production process.

We feel that furnishing Clarage Air Conditioning to several famous laboratories, now making Penicillin, is our most honored war-time job . . . for in these instances, at least, we play some small part in saving human life.

Today all Penicillin is commandeered by the government. But some day, thanks to medical science and air conditioning, it will be made in such quantity as to be a godsend to all mankind.

**CLARAGE**
**FAN COMPANY**

KALAMAZOO, MICHIGAN

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

★ COMPLETE AIR CONDITIONING ★ COOLING
★ VENTILATION ★ FACTORY HEATING
★ MECHANICAL DRAFT ★ FANS AND BLOWERS
FOR INDUSTRIAL NEEDS

# "WINGS" fo

OFFICIAL U. S. NAVY PHOTOGRAPH

**262,500,0FM**
**BY 750IN**

*"The inside of the tank decks of one of the LST's has the appearance of a gigantic garage, and, in fact, that is what it is. In the vast space there is row upon row of tanks, trucks and jeeps.*

*"These LST ships do not dock—they simply drive on to the beach until they ram the ground. Once beached, the ship has to stay there until all the cargo has roared its way ashore. Sometimes the work has to go on all night. Outside everything will be blacked out, while inside is a blaze of light, with the sound of engines starting up, the hum of the lift and the banging of caterpillar treads—and the traffic lights are shining from red to amber and amber to green. The deep hum of the exhaust fans can be heard as thousands of cubic feet of foul fumes are sucked out into the air. If those fans ever stopped, the soldiers working below would be dead in a few minutes."*

# INVASION

## FM AT 1 INCH STATIC PRESSURE DISCHARGED ING AXIAL FLOW BLOWERS ON LST SHIPS

The first "cargo" discharged by the famous LST landing ships is the volume of deadly exhaust fumes given off by the tanks warming up below decks prior to the invasion landing. These fumes are exhausted through a large number of Wing Axial Flow Blowers each delivering 35,000 CFM at 1 inch static pressure. The "cargo" which follows is the world's most powerful armored corps—tanks, trucks, jeeps, motorized artillery — the vanguard of invasion blasting the way to Victory.

These LST's have made possible our successful landings in Tunisia, Sicily, the Italian Mainland, the Solomons, the Aleutians, and will undoubtedly be in the fore of the Invasion of the Mainland of Europe.

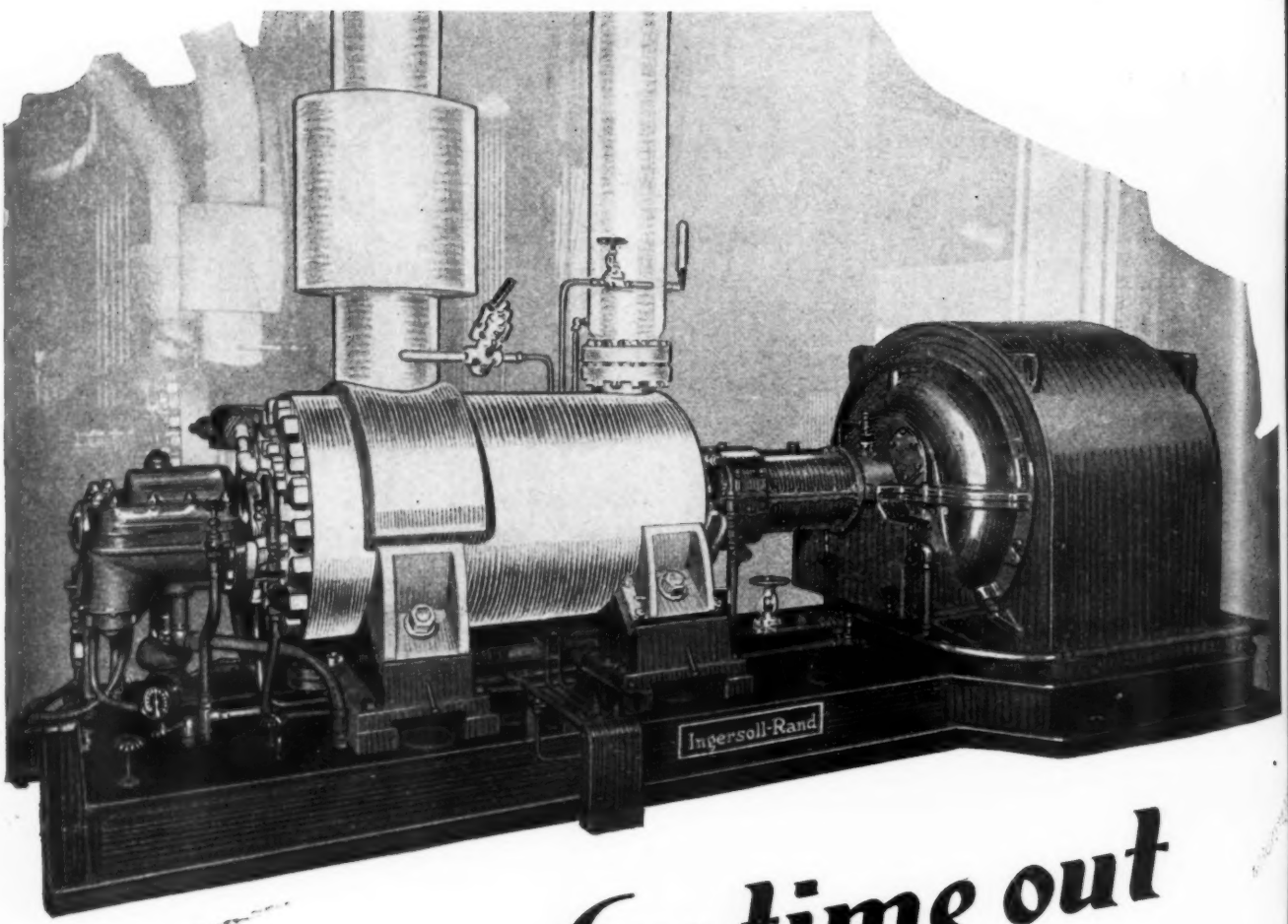
Wing is proud of the fact that its years of pioneering in the ventilation field have thus been climaxed by one of the most important ventilation projects of our time.

**L. J. Wing Mfg. Co.**

**50 7th Avenue** **New York 11, N. Y.**

***Factories:*** **Newark, N. J. and Montreal, Canada**

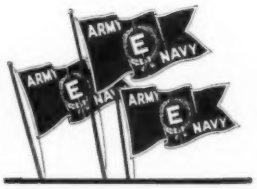
# WING AXIAL FLOW BLOWERS




# No time for time out

These days the only time that counts is production time. Power plants must supply steam and electricity 24 hours a day. Boiler-feed pumps in these plants have to be good.

Ingersoll-Rand boiler-feed pumps have built up a reputation for dependable operation in all types of plants. There is an Ingersoll-Rand pump for the smallest industrial power plant and for the highest pressure central station. Sizes range from 5 to 2500 horsepower — discharge pressures up to 3000 pounds per square inch. Ingersoll-Rand Company, 11 Broadway, New York, N. Y.



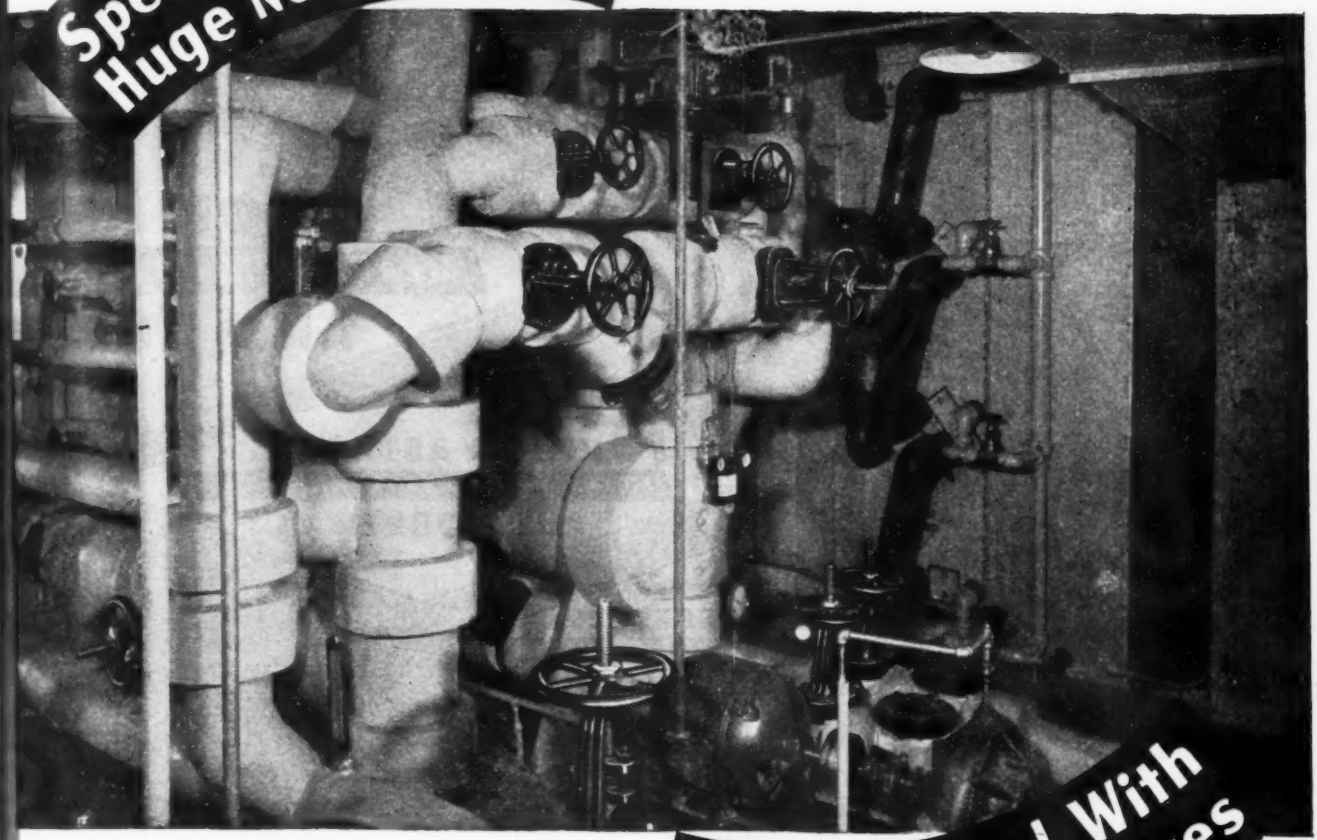

All plants of Ingersoll-Rand Company are flying the Army-Navy "E" awarded "for high achievement in the production of war materials."

**Ingersoll-Rand**

10-256 *Cameron Pump Division*

CENTRIFUGAL PUMPS • COMPRESSORS • BLOWERS • ROCK DRILLS • AIR TOOLS • CONDENSERS • DIESEL ENGINES

# Sperry Gyroscope's Huge New Factory



## Is Equipped With Fairbanks Valves

**Reliable and maintenance-free valves are of utmost importance in war plants. No chances can be taken of delays due to valve failure.**

Fig. 0405

**Fairbanks Valves were selected for over 75% of the installations in the enormous new Nassau Plant of the Sperry Gyroscope Co. which is devoted 100% to war work. Isn't it reasonable to suppose that this well known concern—which in peace time manufactures the famous Gyro-Compass for ships, the Gyropilot for aircraft, etc.—is well qualified to choose the make of valve which has proven the most satisfactory?**

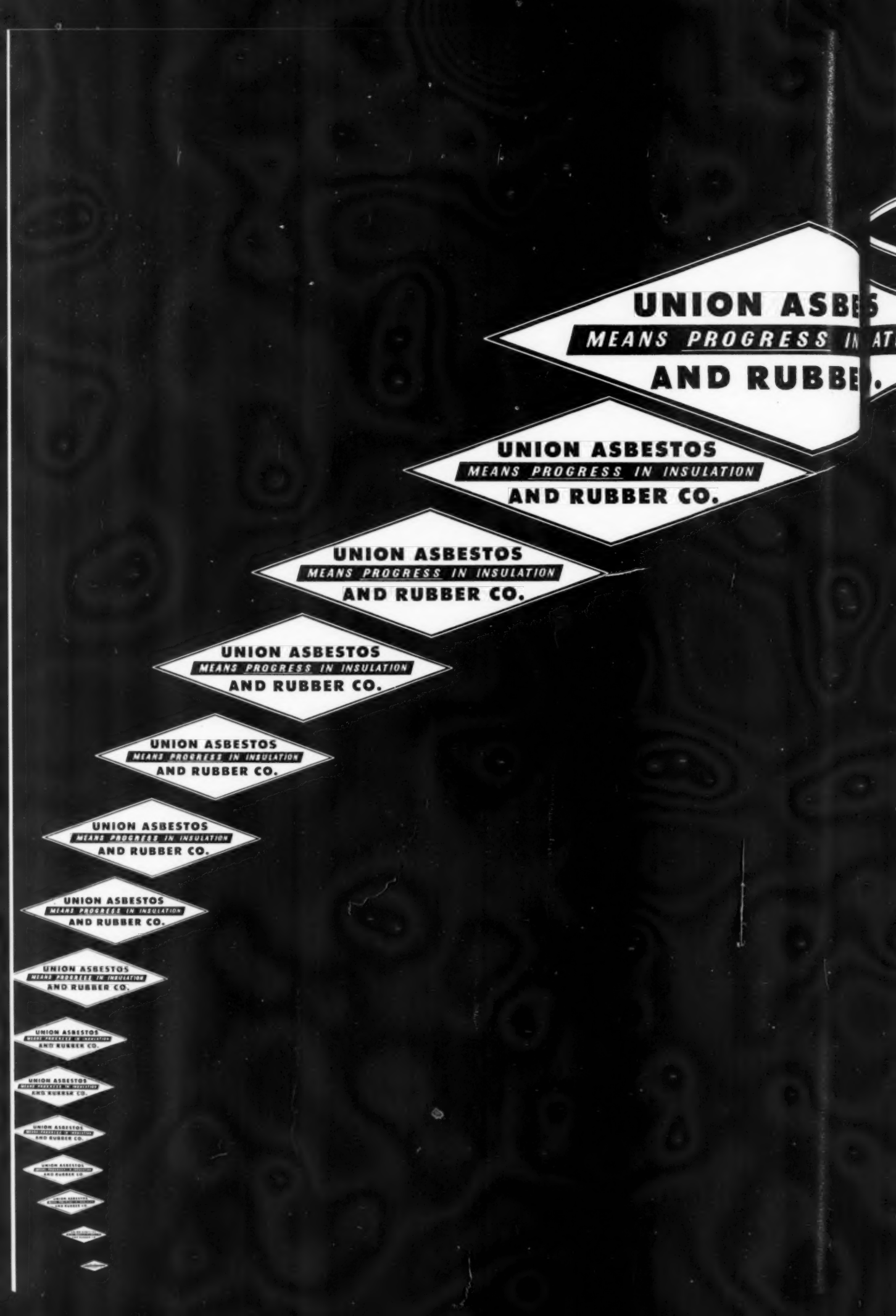
**You can "Bank on Fairbanks Valves," for there is more than 50 years of experience back of them. Write for Catalog and name of our nearest distributor.**

## THE FAIRBANKS COMPANY

393 Lafayette St. New York 3, N. Y.
Boston, Mass. Pittsburgh, Pa.

F

# Fairbanks *Standard and Renewable* Valves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# UNION ASBESTOS
## MEANS PROGRESS IN INSULATION
# AND RUBBER CO.

### 'MEANS PROGRESS IN INSULATION"...

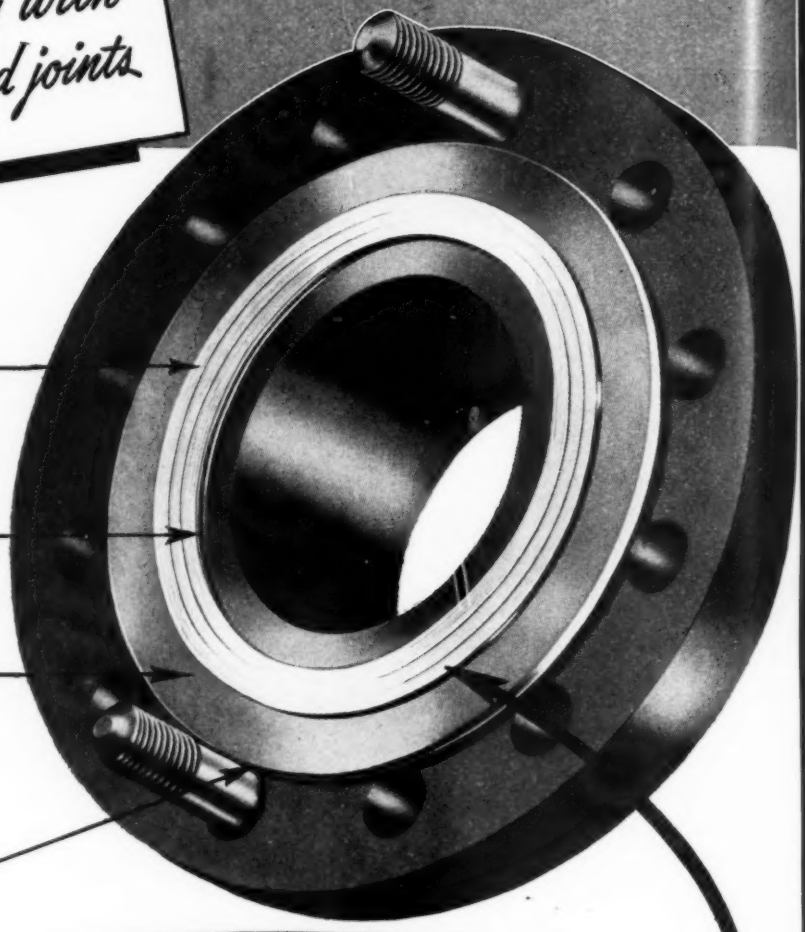
Much that is new in insulation (both manufacturing and application) has been introduced and is being developed by Union Asbestos. This is no idle boast, for such advancements as simplicity of application, higher efficiency and reusability as you will find in Unibestos, Insutube, Insutape, Insubestos Felt and other heat insulations have been developed by Union Asbestos specialists in Industrial insulations, with a background of close collaboration with the nation's mechanical engineers. Union Asbestos and Rubber Company engineers are keeping abreast of new developments in Plant Equipment—and Union Asbestos research is developing insulations that keep pace with the requirements of this new equipment.

PLANTS: CICERO, ILL. • BLUE ISLAND, ILL. • PATERSON, N. J.
OFFICES: 310 S. MICHIGAN AVE., CHICAGO • NEW YORK • SAN FRANCISCO

# KNOW these FLEXITALLIC C-G GASKETS

**They'll play as big a part in peace-time piping as they play now in war**

*Know these technical details —they mean safety with high-pressure flanged joints*

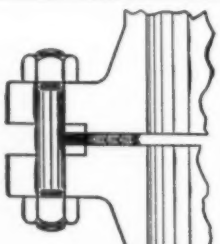


Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I. D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

Correct position assured by O. D. of gauge-ring which fits inside of bolts.



*Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.*

Note the loose fit between the active gasket member and the gauge-ring. This clearance is important. Don't let anybody sell you the idea that the fit should be snug. In a Flexitallic C-G gasket, there is always the right amount of space for the gasket to expand under compression. If the fit would be snug, the body of the gasket could move inward toward the orifice. A Flexitallic gasket moves outward to the ring. That's the right construction and no other is right.

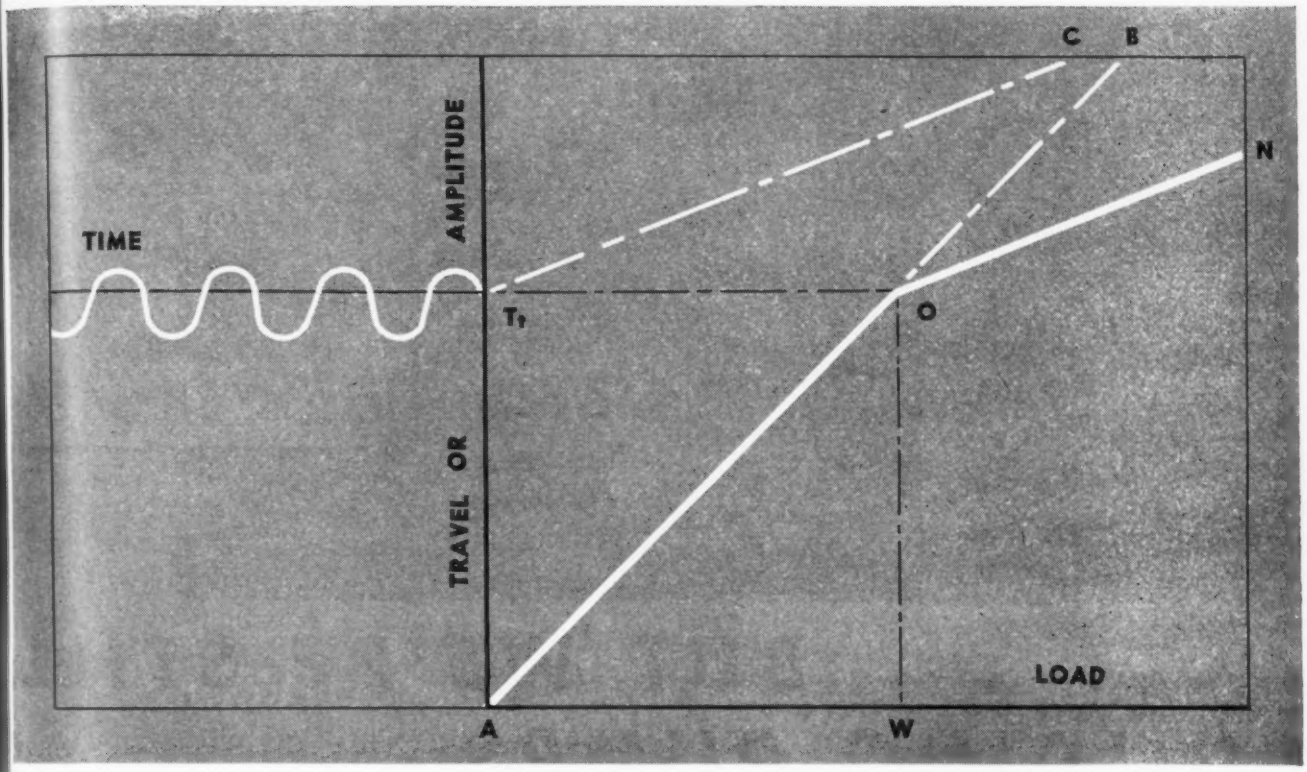
"Flexitallic" Reg. U.S. Pat. Office

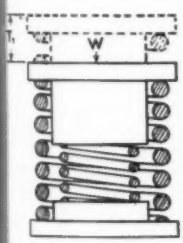
*Representatives in Principal Cities*

**FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.**

*Originators of Spiral Wound Construction*

# NON-RESONANT



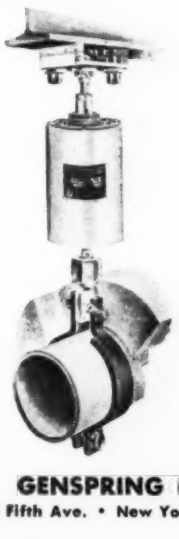




THE principle of the GENSPRING NR Hanger is based upon a parallel arrangement of two helical compression springs as shown in the view at left. The main or outer spring supports the entire weight of the pipe, W, and the inner or smaller spring functions only when vibration occurs. That is, after steam is turned on and a sufficient length of time allowed for the pipe line to come up to the operating temperature, the inner spring is brought into position by a suitable adjustment so that normally without vibration it is unloaded, but with the slightest vibration it is loaded intermittently every half cycle.

The graph of this arrangement is shown above in which line A-B is the load-deflection characteristic of the main or outer spring and line Tt—C is the load-deflection characteristic of the inner spring. Line A-O-N is the combined load-deflection characteristic of both springs. The bend or "knee" in the curve can, by means of the adjustment previously mentioned, be shifted to any position where the weight, W, comes to rest at the elevated temperature.

The purpose of the foregoing arrangement is to assure that the characteristic of any impressed vibration will straddle the "knee" so that half of the cycle occurs with a hanger stiffness factor and corresponding natural period of one value, and every alternate half cycle with a hanger stiffness factor and corresponding natural period of a different value. This prevents or greatly minimizes resonance because insufficient time is allowed for the resonant amplitude to develop. This is equivalent to employing time as a damping factor.

For application of this principle to your pipe-suspension problems, send for our Bulletin No. 101 which gives full particulars as to load ranges and sizes of units.

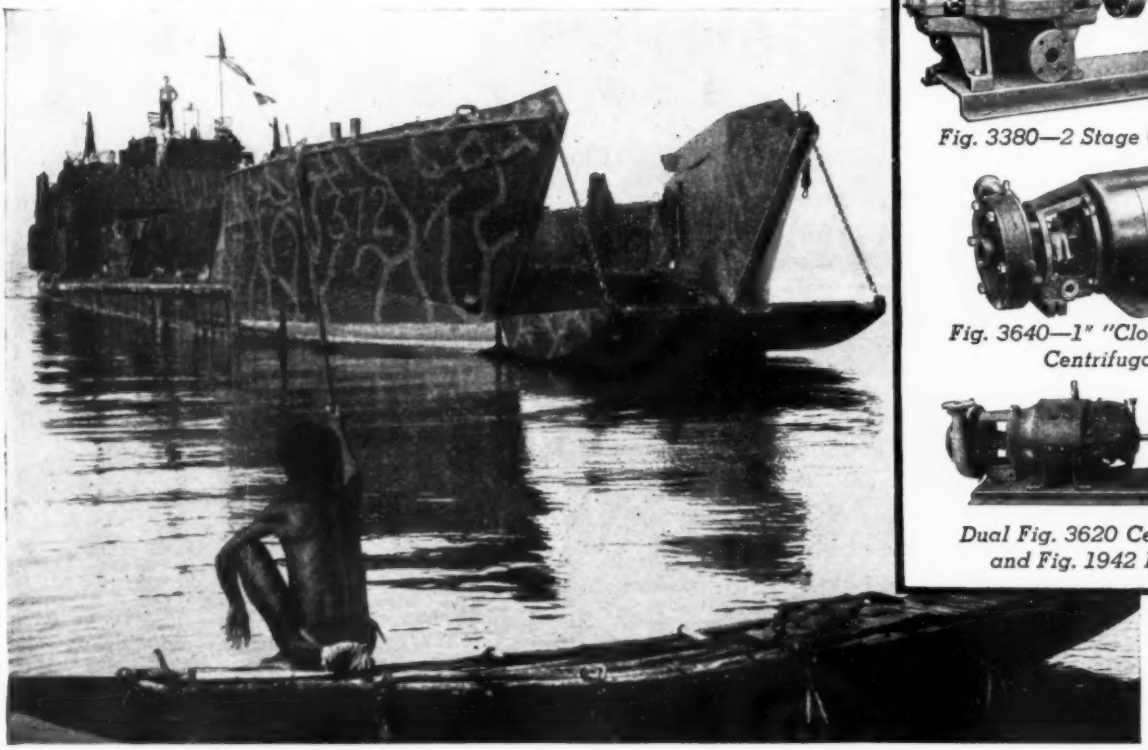


**GENSPRING INC.**
500 Fifth Ave. • New York 18, N. Y.

## GENSPRING NR HANGER

NON-RESONANCE • LOW-HEADROOM • LATERAL FLEXIBILITY • DURABLE SPRING DESIGN • LOAD ADJUSTABILITY • LOW HEAT CONDUCTIVITY

## *a few of the Goulds pumps built for U. S. Landing Craft*



*Official U. S. Signal Corps Photo*

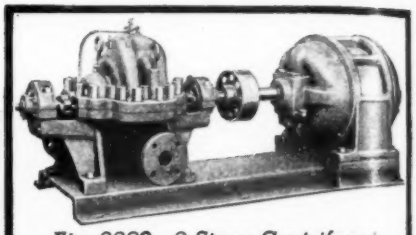
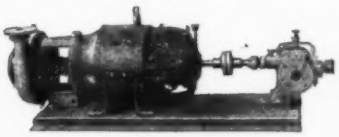


*Fig. 3380—2 Stage Centrifugal*

*Fig. 3640—1" "Close-Cupld" Centrifugal*



*Dual Fig. 3620 Centrifugal and Fig. 1942 Rotary*

# . . . . . BUT WE'RE STILL BUILDING PUMPS

This is a frank statement of facts.

Our nation is at war. The very principles upon which this great country of ours were founded are in peril. Our first duty—yes, our foremost desire—is to render every possible aid we can, as a company and as individuals, to the government whose responsibility it is to see this war through to a successful finish in just as short a time as possible.

We have been supplying pumps for the armed services in ever increasing quantities since before Pearl Harbor. Right now, certain shipbuilding programs of the Navy are particularly urgent. Schedules have been stepped up to such an extent that a large share of our facilities are devoted to the production of such pumps as are a vital part of the program. That we have the facilities, that the government has confidence in our ability to produce their requirements on schedule, is gratifying to us. We would not have it otherwise.

We realize, however, that this situation is proving a hardship to our regular customers—customers, who in many cases, have been buying their pumps from us for years. Their need for pumps is undoubtedly urgent but this is war and our first responsibility is to our fighting men. Whatever facilities we have available, beyond the needs of these extremely urgent programs, are at the disposal of our customers for priority orders. As these facilities permit, we will endeavor to the best of our ability to take care of their pump requirements, making the best possible delivery we can under these difficult conditions.

But we *are* still building pumps . . . and pumps alone. That means we are going to have no conversion problems when the fighting is over. We are acquiring valuable experience in volume production and improved designs. After the war, we will be in a better position than we have ever been in all our 96 years to serve our regular customers with better equipment, a broadened knowledge of pumping problems and to give improved deliveries.

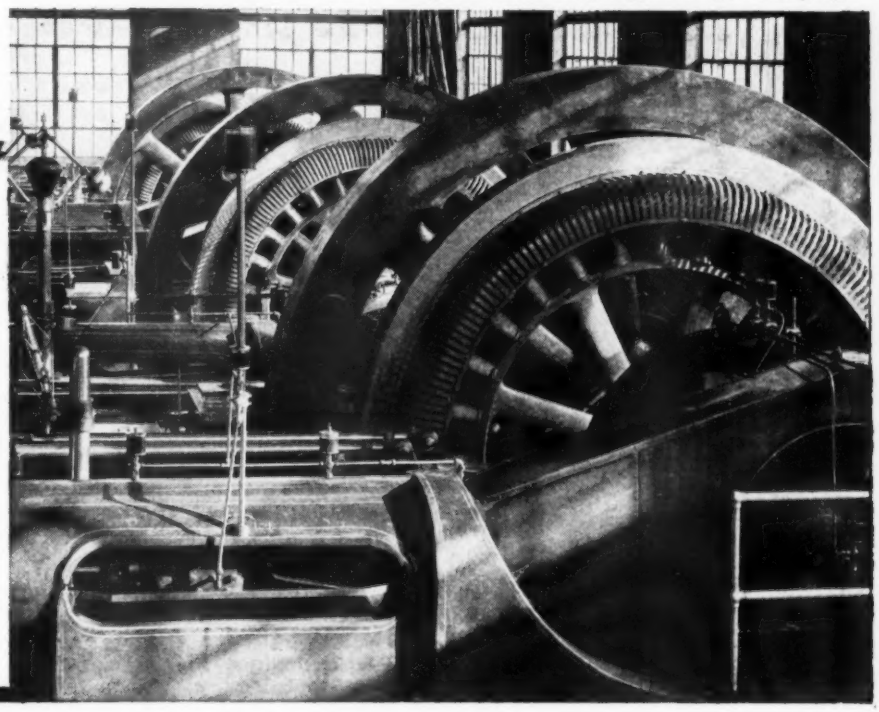
Until that day, we can only ask you to bear with us as far as possible . . . and to remember that Goulds still builds "*the* pump for *the* job."

**Goulds PUMPS, INC.**

**SENECA FALLS, NEW YORK**

*Official U. S. Army Signal Corps Photograph*

**POWER TO ATTACK**
relies on *power production.*
For stepped-up output from
*STEAM* engines use . . .



**. . . SINCLAIR STEAM CYLINDER and VALVE OILS.** These oils meet wet, dry, or superheated steam requirements . . . suit all engine designs and operating characteristics . . . provide *safe* lubrication under continuous full loads or emergency overloads.

*(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)*

# SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY (INC.), 630 FIFTH AVENUE, NEW YORK 20, N. Y.

# CHASE ANTIMONIAL ADMIRALTY†

**For salt or brackish cooling water conditions, here's a condenser tube alloy that offers extraordinary resistance to dezincification. Consider: of the millions of pounds of Chase Antimonial Admiralty tubes in service—many of them installed in 1935—not a single case of service failure from dezincification has been reported.**

**Yet Antimonial Admiralty actually costs no more than plain Admiralty. These are the facts in brief ...noteworthy in picking a condenser tube alloy. For full information, just phone the nearest Chase Sales Service Office.** †U. S. Pat. No. 2,061,931

## POINTS TO REMEMBER

**Chase Antimonial Admiralty offers you outstanding service life, because it is:**

1. **Highly Resistant to Dezincification**
2. **Free from Intercrystalline Corrosion**
3. **Costs No More Than Plain Admiralty**

CHASE

**CHASE BRASS & COPPER CO.** *Incorporated,* **WATERBURY, CONN.**

*Subsidiary of Kennecott Copper Corporation*

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✶ *Sales Office Only*

*This is the Chase Network —handiest way to buy brass*

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY *at*
Houston
Los Angeles
New Orleans
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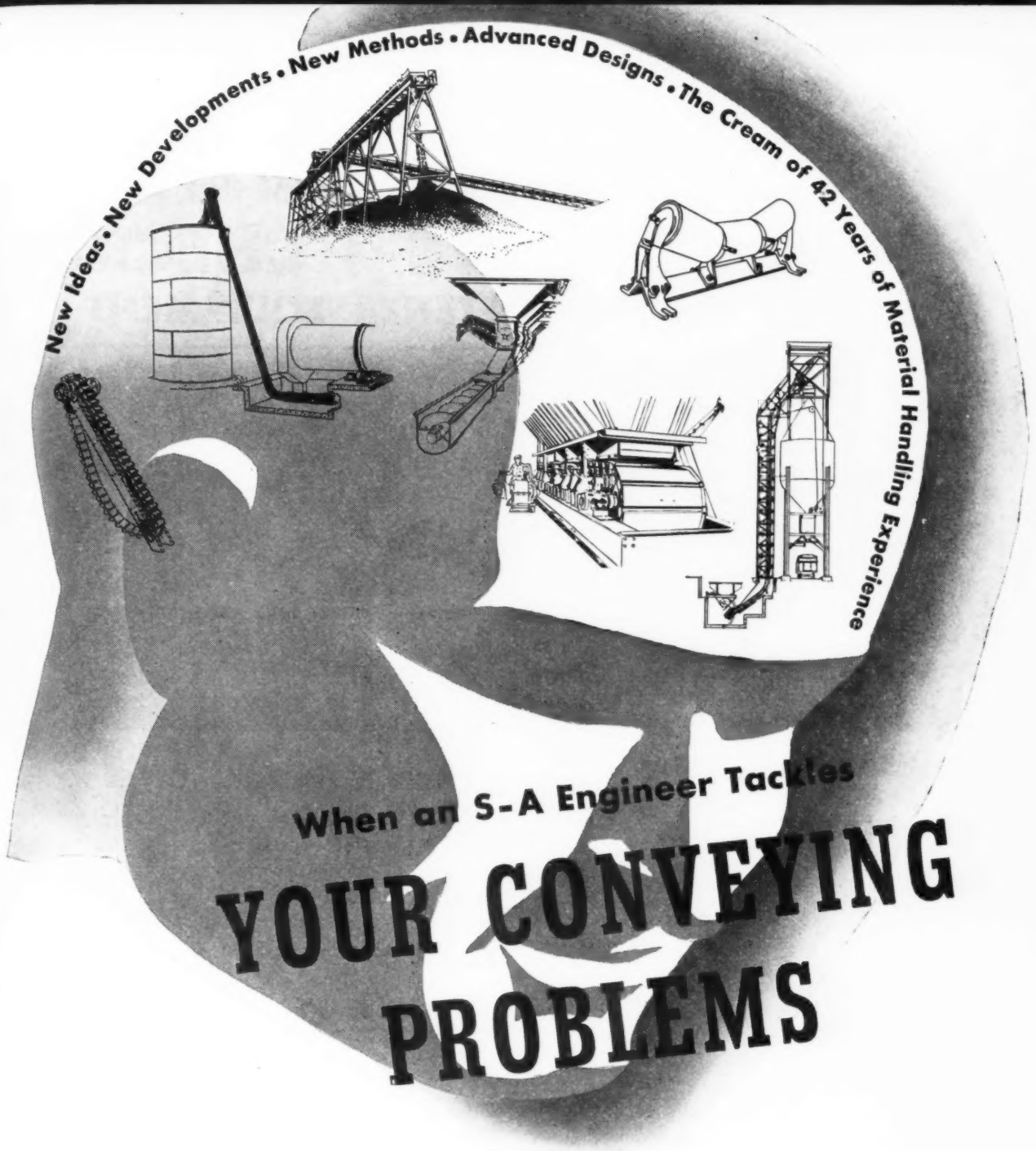



## When an S-A Engineer Tackles

# YOUR CONVEYING PROBLEMS

• An S-A Engineer has literally a brain-full of material handling ideas and methods, each one backed up by a wide variety of material handling units for putting a planned layout into operation.

It is the S-A Engineer's job to study and analyze *your* handling problems... and to prescribe the *proper method and equipment* necessary to do the job efficiently and economically.

Stephens-Adamson Engineers represent an organization which has, for 42 years, devoted its time and energies exclusively to the development and production of better material handling methods and equipment.

Whether your plans call for immediate action, or for improved material handling systems to be installed for post-war operation, S-A Engineers are ready to serve you.

**STEPHENS-ADAMSON MFG. CO.**
5 Ridgeway Avenue, Aurora, Illinois
Los Angeles, Calif. Belleville, Ont.

**STEPHEN S-A ADAMSON**
MFG. CO.

*Designers and Manufacturers of All Types of*
**BULK MATERIAL HANDLING EQUIPMENT**

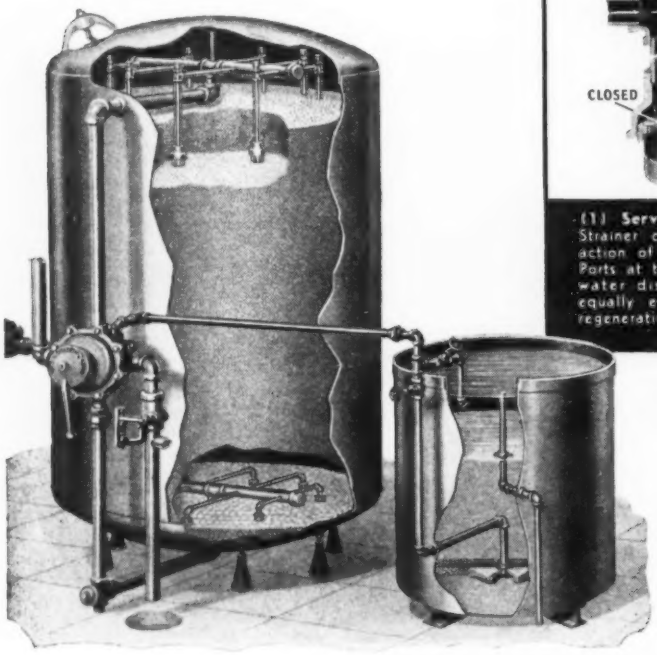
# "44% more capacity"

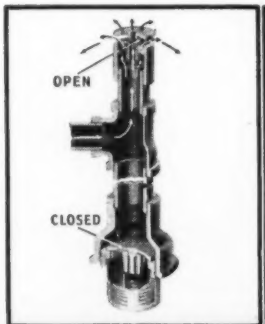
## —say more than 2200 users of the

# ELGIN DOUBLE W CHECK

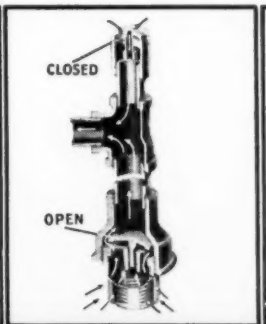
## ZEOLITE WATER SOFTENER EQUIPMENT

**Double-Check Manifold can be installed in any make of softener**

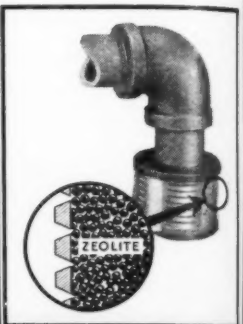





(1) **Service position.** Strainer closed off by action of lower check. Ports at top give even water distribution — equally effective when regenerating.




(2) **Backwashing.** Strainer now open. Greater part of wash water passes through it; balance through small ports in top. This flushes out foreign matter without zeolite loss.




(3) **Lower strainer nozzle.** Section through strainer shows shape of slots which prevent loss of zeolite when softening and gives free action when backwashing.

### THESE ARE THE ADVANTAGES YOU GET:

- W Up to 44% more softened water
- W Prevention of zeolite loss
- W Less salt consumption
- W No packing or channeling
- W More thorough backwashing
- W Self-cleaning action

## A SMALL CHANGE MAKES A BIG DIFFERENCE

*THE big difference* is summed up in those six advantages listed above. Check them over. They are fully confirmed by a long list of users who report up to 44% more soft water output from a softener of given size along with reduced salt consumption and minimum loss of zeolite.

*The small change* is the Elgin Double-Check manifold explained by the illustrations above. The equipment is at its best as a part of the new Elgin Double-Check Softener, but you can obtain a remarkable increase in the capacity and efficiency of your present softener (any make) by having it installed as here illustrated and described. The primary purpose of the Double-Check manifold is to permit a *higher bed of zeolite* in a given size tank—and of course it's the zeolite that does the work. Former attempts to increase the amount of zeolite in softeners of conventional design have resulted in a loss of zeolite to the drain when backwashing. The only way to prevent this loss and still have a sizeable bed, was by reducing the backwash flow rate. But this slow rate was insufficient to properly clean the zeolite, and, worse still, permitted packing and channeling of the bed.

The Double-Check manifold has changed all this. It stops the escape of zeolite despite the far deeper bed carried. As a result, a rapid backwash rate can be used, cleaning the zeolite fully and loosening it up uniformly so that the salt solution can readily surround the grains of zeolite and regenerate them far more efficiently. Still another ingenious feature is the method of eliminating suspended impurities through the ports in the top of the upper manifold system.

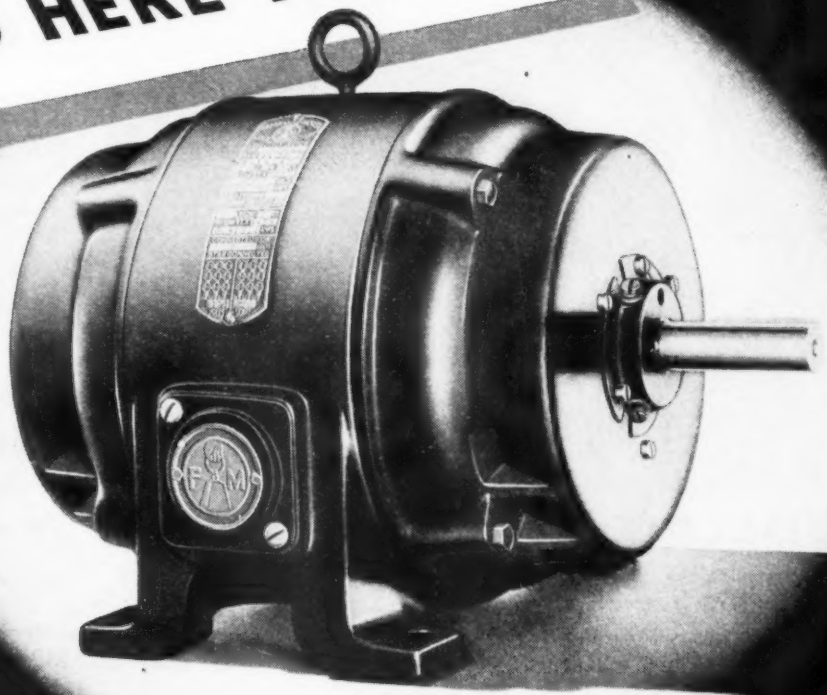
The detailed story of these and other features of the Double-Check equipment is told in a new bulletin that is yours for the asking. Write today for your copy.

**Modernize Your Water Softener With Double-Check Manifold**

The Double-Check manifold is in key with today's program of saving materials by modernizing existing equipment. Let us show you how we can step up the capacity and efficiency of your present softener!

**ELGIN SOFTENER CORPORATION, 130 North Grove Avenue, Elgin, Illinois**

# TOMORROW'S MOTOR IS HERE TODAY!



WITH *Copperspun* ROTOR

YOU can buy this new postwar designed Fairbanks-Morse motor now—*knowing* that it will be just as modern—just as efficient—just as up to the minute in years to come as it is today.

It is indeed a challenge to the future—in efficient motor design.

- It is a 40°C. motor.
- It is a protected motor!
- It has the most adaptable, convenient, and handiest conduit box you ever laid your eyes on!
- It has the famous Fairbanks-Morse COPPER-SPUN Rotor!

## Important!

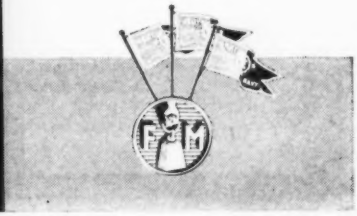
Never before has there been more stamina—more protection—more versatility built into a motor housing. A demonstration is necessary to fully appreciate how much this motor can really offer you. See it and judge for yourself.

**Write Fairbanks, Morse & Co., 213 Fairbanks-Morse Bldg., Chicago 5, Ill.**

# FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

Motors



## THE TOLEDO SIMPACT 1" TO 2" RATCHET THREADER

—certainly fills the bill. Self-contained. No loose parts. One set of high speed steel dies threads all four sizes of pipe. Sizes changed rapidly. Work holder is simple and designed for long service. Ample length handle.

Specify a "TOLEDO" Simpact at your Dealers next time.

**THE TOLEDO PIPE THREADING MACHINE CO.**

**TOLEDO, OHIO** "TOLEDO" **NEW YORK OFFICE, NO. 2 RECTOR ST.**

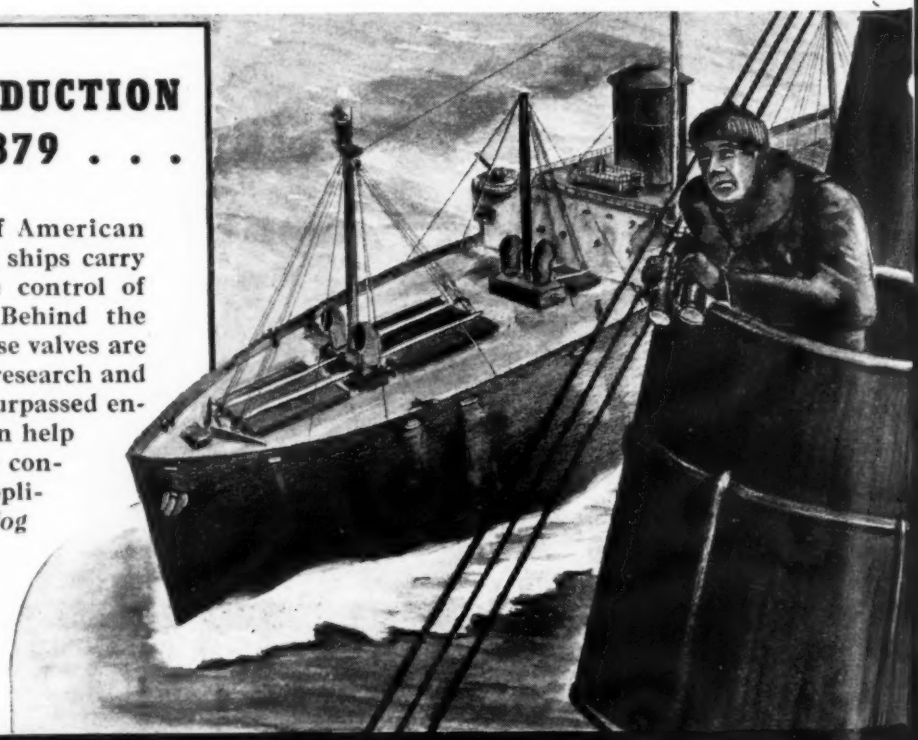
**BUY WAR BONDS** **BUY WAR STAMPS**

## OUR WAR PRODUCTION STARTED IN 1879 . . .

A notable majority of American freighters and fighting ships carry K & M valves for the control of levels and pressures. Behind the bronze and steel of these valves are 65 years of specialized research and development. This unsurpassed engineering experience can help solve level and pressure control problems in *any* application. *Write for Catalog No. 66.*

**SPECIAL REPAIR DEPARTMENT**

If you can't get *new* K & M valves and controls, send us your old equipment for repair. By George, we'll do it *fast* . . . 10 days to 2 weeks, maximum!



**KIELEY & MUELLER, INC**

PRESSURE AND LEVEL CONTROL SPECIALTIES

**NORTH BERGEN, NEW JERSEY**

# MAKE USE OF THESE 4 WAYS TO PREVENT Condenser Troubles

● **Eliminate Air**—Cut tube end erosion by installing air and erosion eliminators. These removable screen plates, fitted with air ejection piping, remove air from circulating water before it attacks tube sheets and tube ends. Increase tube life from three to seven times in the average installation.

● **Detect Weak Tubes by Shock Test**—The 10-year-old hydro-dynamic Shock Test destroys tubes just ready to fail. Frequently, less than ten percent of the tubes in large condensers require replacement, but, unless discovered and removed, they will soon necessitate another shut-down and even major overhaul. Only by Shock Test can you mechanically and accurately distinguish good tubes from bad.

● **Stop Tube End Wear**—Use FLOWRITES, replaceable, bell-mouthed sleeves at entrance ends of either new or old tubes. They provide smooth, directed flow of circulating water, eliminating air pockets and preventing air caused erosion of tube ends and pinholes.

● **Stop Tube Leaks—Fast**—The WIZARD Injector and Special Sealing Compound will stop tube leaks in a few seconds.

✔ **Don't Scrap Tubes with Worn Ends**—Even tubes with ends worn through can be salvaged. If they withstand the Shock Test, we can stretch them to usable lengths, cut off the bad ends and return them to service.

★ ★ ★

In holding down condenser maintenance costs, the Big League Utilities have kept our facilities and our field crews busy for seventeen years. Today, uninterrupted flow of power for war production is more essential than ever.

Avoid breakdowns and priority holdups by taking advantage of Conseco nation-wide, clock-around service. A letter, telegram or 'phone call will start your job rolling. Estimates furnished for specific work.

## Condenser Service
## AND ENGINEERING CO., INC.

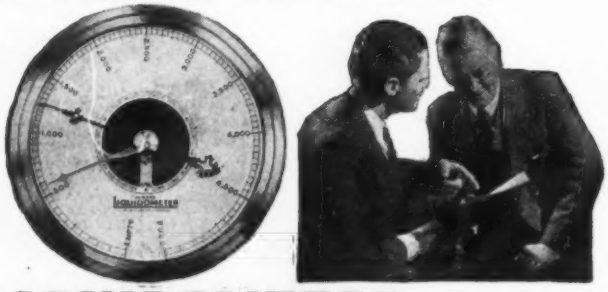
**81 RIVER STREET, HOBOKEN, NEW JERSEY**

★

**NEW JERSEY TELEPHONE—HOBOKEN 3-4425**

**NEW YORK TELEPHONE—RECTOR 2-9360** **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

THOSE WHO CAN'T AFFORD TO MAKE ERRORS IN MEASURING VALUABLE STORED LIQUIDS CHOOSE—



LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.
No pumps, valves, or auxiliary units needed to read them.
Models available for either remote or direct readings.
Accuracy unaffected by specific gravity of tank liquid.
Approved by Underwriters' Laboratories for gauging hazardous liquids.

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THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, I, N.Y.

For Safe Boiler Operation

*The Genuine* Squires

Boiler Feed Water Controller

will maintain a constant water level in your boilers and will feed them in proportion to the evaporation.

Write for Catalog A-12 now

The feed valve is operated by boiler pressure —insuring positive functioning.

Squires

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THE C. E. SQUIRES COMPANY

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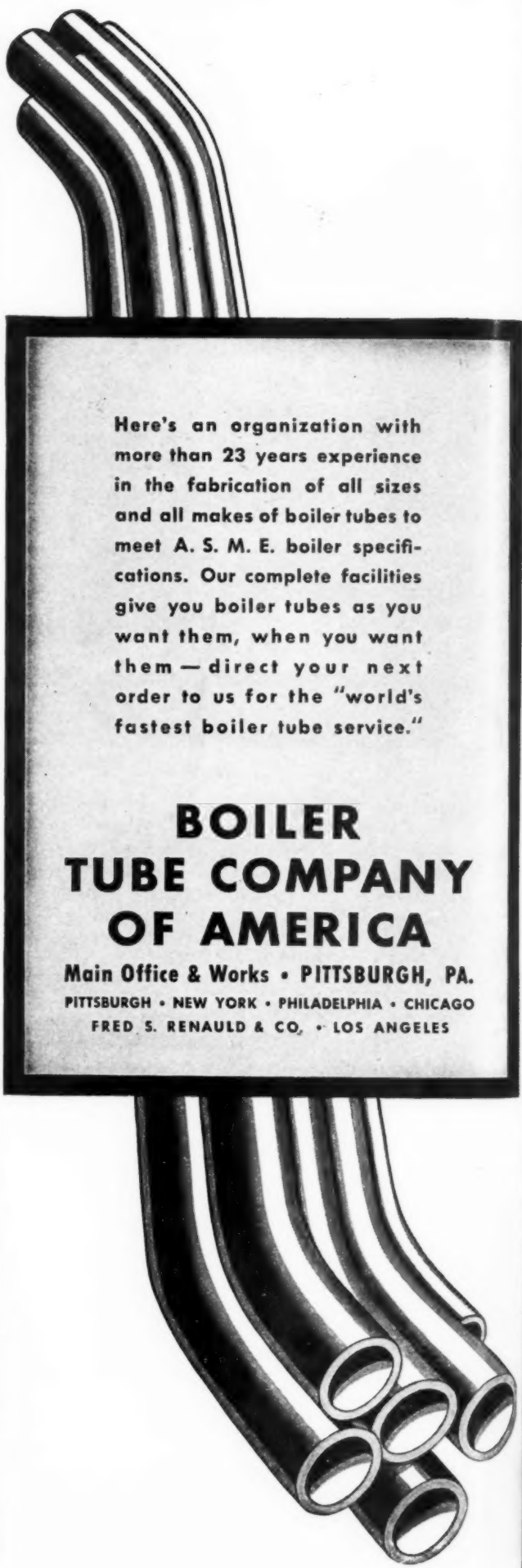

Here's an organization with more than 23 years experience in the fabrication of all sizes and all makes of boiler tubes to meet A. S. M. E. boiler specifications. Our complete facilities give you boiler tubes as you want them, when you want them — direct your next order to us for the "world's fastest boiler tube service."

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Main Office & Works • PITTSBURGH, PA.

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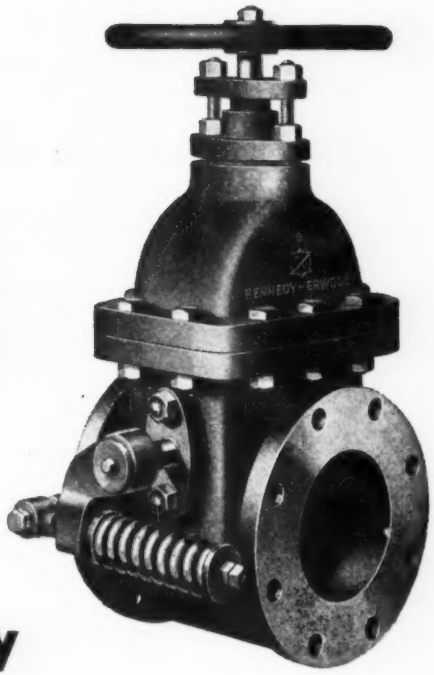
FRED S. RENAULD & CO. • LOS ANGELES



# INVESTIGATE
## this aid to greater plant safety

The Kennedy-Erwood Safety Swing Gate Valve protects low pressure apparatus from excessive pressures. Its ingenious safety feature is the spring-controlled disc, which enables the valve to be closed as a standard gate valve, but which opens automatically at a predetermined back pressure to relieve excessive unbalanced pressure. This design therefore combines the functions of a gate valve, check valve and relief valve in a single unit. It has proven its benefits in service as a non-return valve, back-pressure valve, atmospheric relief valve, and safety gate valve, wherever low-pressure apparatus should be protected against building up of excessive pressures.

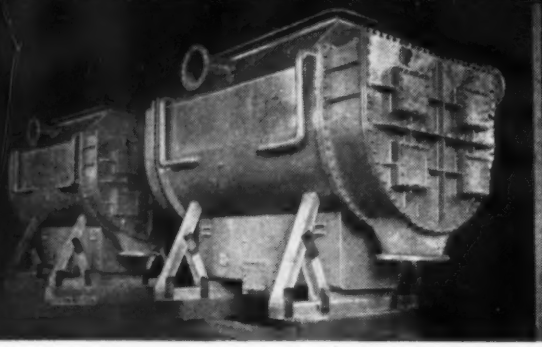
The design and features of the Kennedy-Erwood Valve are fully explained in the new 240-page Kennedy catalog, which also includes bronze and iron-body gate, globe, angle and check valves for a wide range of pressures, bronze and malleable iron screwed pipe fittings, and cast iron flanged fittings. Every valve user should have a copy of this helpful catalog. Your copy sent free on request.

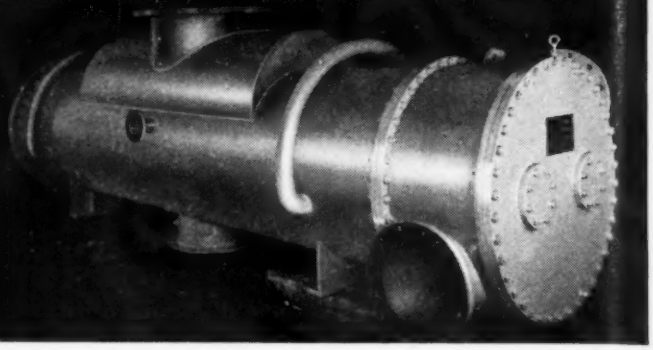
**THE KENNEDY VALVE MFG. CO.** **ELMIRA, N. Y.**

**KENNEDY *valves... pipe fittings... fire hydrants***

# SURFACE CONDENSERS

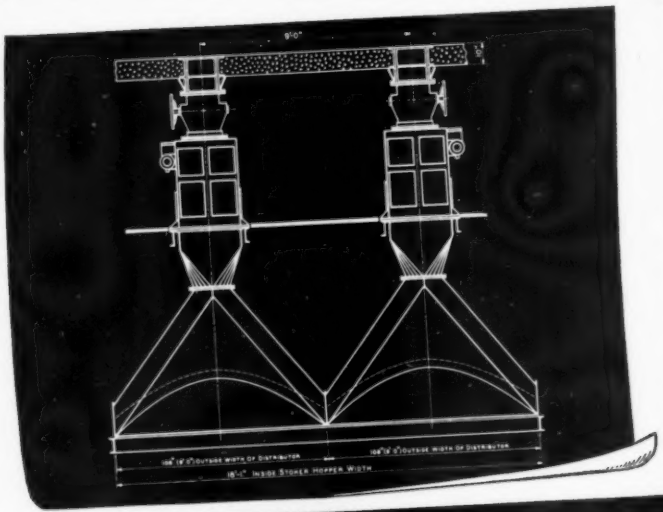
Conservative design . . . by an engineering personnel . . . to whom may be credited such developments as . . . the all welded steel plate shell surface condenser . . . the integral condenser waterbox . . . an improved condenser tube layout . . . modern steam jet refrigeration . . . the single nozzle air ejector . . . and other important contributions to the art of building finer heat transfer equipment . . .





# GRAHAM MANUFACTURING CO., INC.

## Why Specify S.E.Co. Complete Bunker to Stoker Installations?

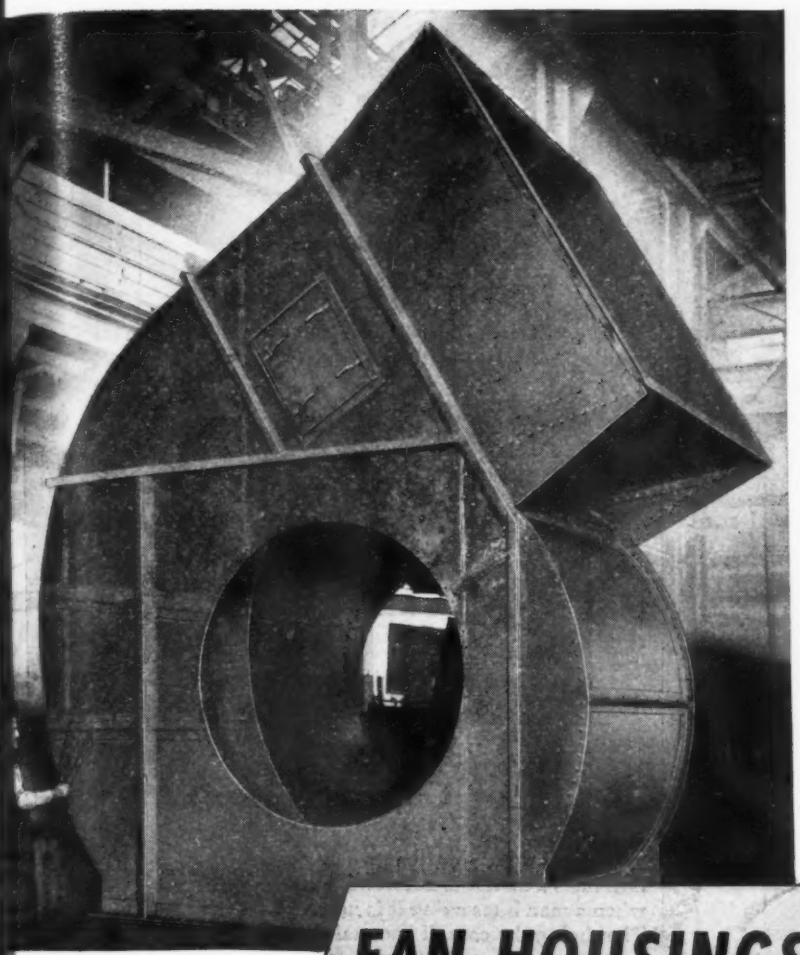


S.E.Co. complete Bunker to Stoker installations are marked by thorough and painstaking consideration of every detail of design. Each unit in the complete system is engineered to be dust-tight and to insure freedom from coal-sticking. Scale floor inserts and Cast Iron Bunker Outlet Collars for concrete construction . . . mathematically correct placement of supports . . . these and many other features insure long, efficient service-life. Plant appearance has been considered and each unit embodies clean workmanlike appearance.

STOCK

Write today for complete design and construction data covering S.E.Co. Bunker to Stoker installations to suit your job. Address inquiries to Stock Engineering Company, 9807 Theodore Avenue, Cleveland, Ohio.

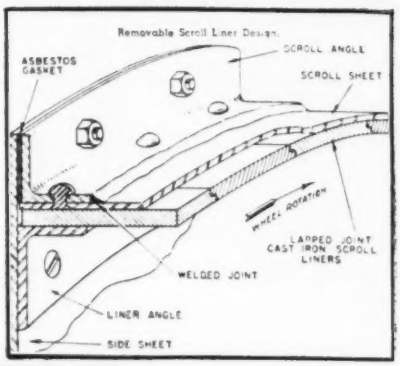
CONICAL Non-Segregating Coal Distributors ★ ENGINEERING CO. ★ S. E. Co. Coal Valves and Coal Scales



# FAN HOUSINGS FOR FLY-ASH

No one has found out how to keep fly ash from wearing out induced draft fan housings and rotors. However, you can minimize this wear—buy equipment that is convenient to keep in service.

1. **Not complete welded housings but a combination of welded and bolted construction providing access to all replaceable parts without dismantling ducts or inlet boxes.**
2. **Removable scroll sections of convenient handling size.**
3. **Quick latching clean-out doors.**
4. **Smooth liners with no protruding bolts or rivets—easily removed and replaced section-by-section.**
5. **Rotor and shaft removable without disturbing inlet boxes or removing shaft separately.**
6. **Housing design with low air velocities—keeping down abrasion to a minimum.**




Buffalo Induced Draft Fans offer these positive maintenance aids. Ask us for details.

**BUFFALO FORGE COMPANY**
**488 Broadway** **Buffalo, N. Y.**
**Canadian Blower & Forge Co., Ltd., Kitchener, Ont.**

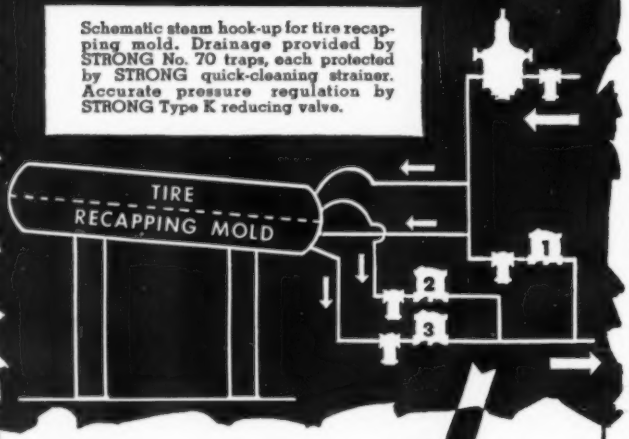
"Buffalo" "First For Fans"

# INDUCED DRAFT FANS

# STEAM WORKS HARDER

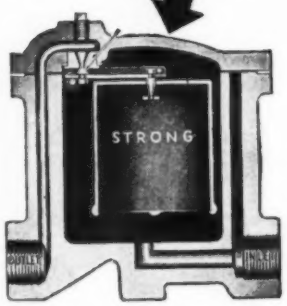
## with the RIGHT TRAPS in the RIGHT PLACES

Schematic steam hook-up for tire recapping mold. Drainage provided by STRONG No. 70 traps, each protected by STRONG quick-cleaning strainer. Accurate pressure regulation by STRONG Type K reducing valve.




On Tire Recapping Units, complete condensate drainage is needed to assure the correct amount of heat at the mold. Three STRONG inverted bucket traps drain the (1) supply line (2) upper mold (3) lower mold.

The condensate rate is low, therefore, the patented STRONG anti-balancing device is valuable in preventing the "dribbling" which causes excessive wear. Strainers ahead of each trap prevent scale and dirt from interfering with operation.




STRONG 70 Series Trap Semi-Steel—for saturated steam to 150 p. s. i. working pressure.

• • •

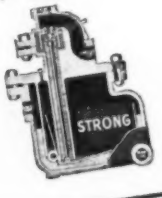
Completeness of the STRONG lines enables us to recommend exactly the type and size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—forged, fabricated, (welded), cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland, Ohio.

OTHER STRONG STEAM SPECIALTIES

Reducing Valves

Strainers

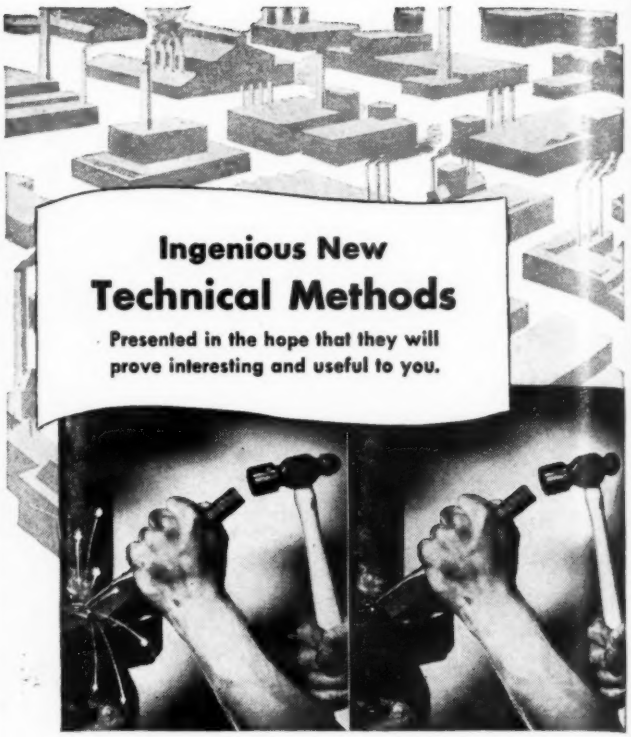
Open Bucket Traps




P-343

**STRONG**

STEAM SPECIALTIES

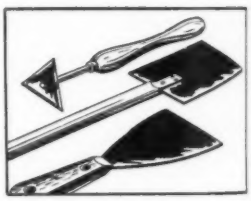



## Ingenious New Technical Methods

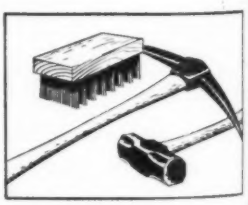
**Presented in the hope that they will prove interesting and useful to you.**

## Beryllium Copper Bites Into Steel

It is an old saying that when a dog bites a man it is not news, but when a man bites a dog it is news. That being the case, it is certainly news when copper bites into steel. Copper is, of course, one of the softer metals but when 2 percent beryllium is added to copper, its characteristics are changed. The alloy is heat treatable which explains the remarkable strength and hardness. Hit a chisel made of Beryllium Copper with a hammer and it will bite into steel without dulling the edge. Tools made of Beryllium Copper are non-sparking and therefore are used in ordnance plants, oil refineries and other places where explosions may occur from sparks off steel tools. Tensile strength as high as 200,000 lbs. psi can be obtained with Beryllium Copper; hence, it is used for many applications where resistance to high loading and impact fatigue are important, such as airplane motor bushings. Most of the critical springs and diaphragms used in aviation, Navy and Signal Corps instruments are made of Beryllium Copper because of its reliability as a spring material.



Man has tried for ages to rediscover the art of hardening copper. Today this can be done by adding to copper a small percentage of beryllium.



Not only does it produce an alloy harder than tempered steel, but one that does not produce sparks, an essential when working near highly combustible materials.

We hope this has proved interesting and useful to you just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for victory.

*You can get complete information about these tools from the Beryllium Corporation, Reading, Pennsylvania.*

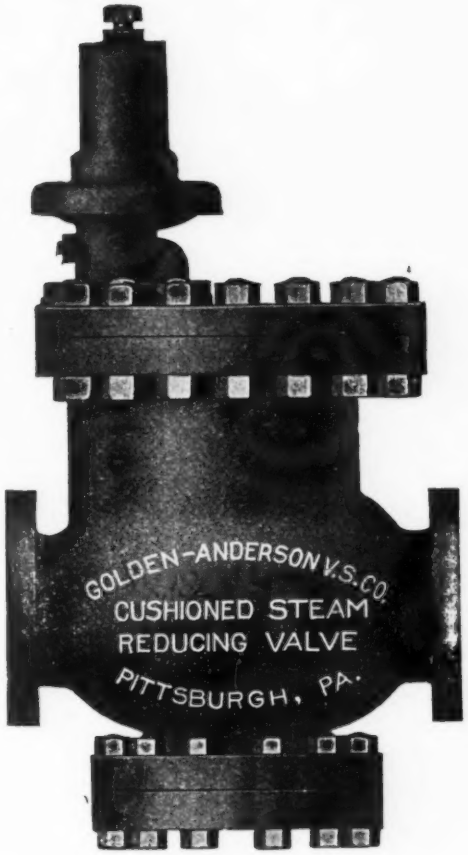
X-65

# Specialty Valves

by GOLDEN-ANDERSON

## STEAM PRESSURE REDUCING VALVE

• Adaptable to various intermittent and dead-end services this G-A Special-Service Valve insures uniform terminal pressure regardless of varying conditions. It is constructed Double-Extra-Heavy throughout and will efficiently handle 125 to 400 lbs. of saturated or superheated steam. Valve may be direct-controlled or operated by remote Pilot control. The Steam Pressure Reducing Valve is furnished in sizes ranging from 2½" to 12", with trim of Bronze, Monel Metal or Stainless Steel.



*SEND TODAY FOR THIS CATALOG . . . CONTAINS COMPLETE CONSTRUCTION AND APPLICATION DATA ON THESE G-A VALVES*

Triple and Single Acting Non-Return Valves • Throttle and Emergency Stop Valves • Electric Emergency Trip Valves • Steam Pressure Reducing Valves • Water Pressure Reducing Valves • Check and Relief Valves • Altitude Control Valves, Single and Double Acting • Float Control Valves • Water Strainers • Electric and Manual Water Service Valves • Coke-Quenching Valves • Standpipe Valves • Solenoid Operated Valves.

# GOLDEN-ANDERSON
## VALVE SPECIALTY COMPANY

1300 FULTON BLDG., PITTSBURGH, PENNSYLVANIA

# Wheelco . . . .

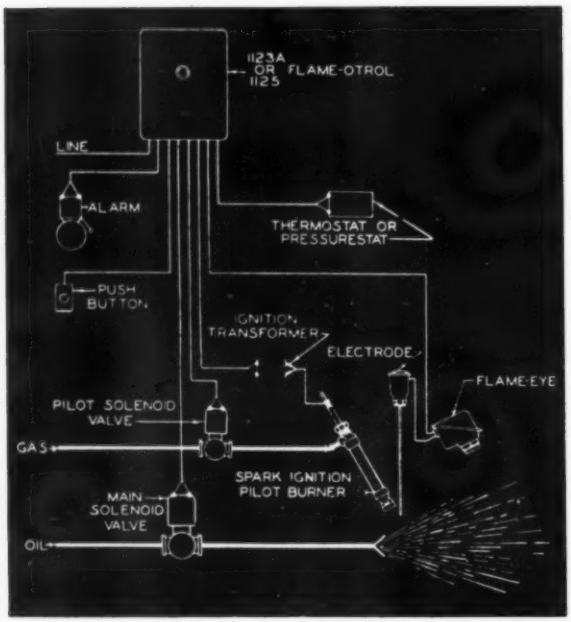
# FLAME-OTROLS

(Electronic Combustion Safeguard)

## PROTECTS OIL BURNER OPERATION against explosion hazards

This Wheelco pioneered electronic achievement gives you PROTECTION against explosion hazards by instantly shutting off fuel to the burners upon failure of the flame. Flame-otrol may be combined with any type of temperature or pressure controllers. The Wheelco Flame-otrol is available with automatic or manual ignition, time delay for purging, or other desirable sequences. It operates with equal efficiency on gas, oil, powdered coal, or any combination of these fuels.

Write for Bulletin L2 for complete information.



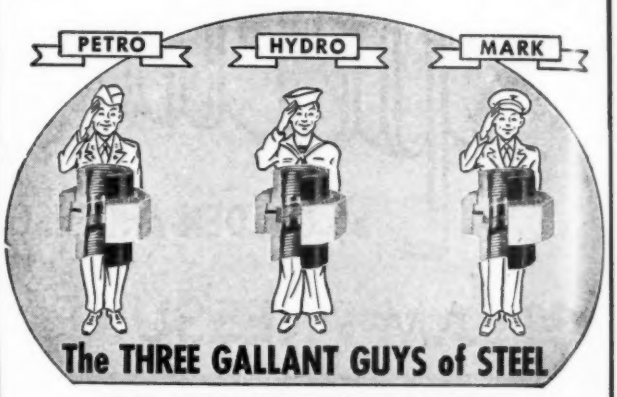

## Wheelco Instruments Co.

863 W. HARRISON STREET • • • CHICAGO 7, ILLINOIS

*"Electronic Principle" Temperature Controls*



# FORGED STEEL UNIONS

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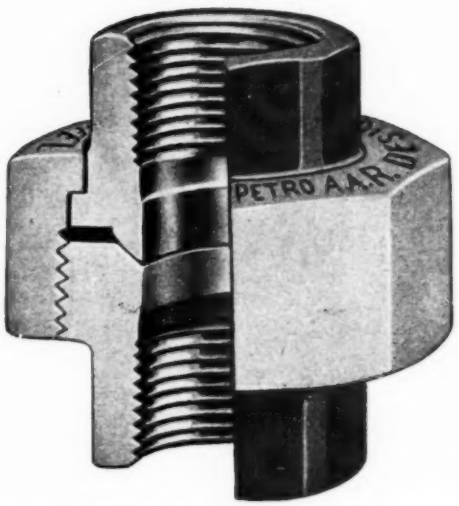
**With 3 Important Service Features ON PETRO**

1. **Durable Strength.**
2. **Permanently Lubricated Nut Threads.**
3. **Intregal Steel Seats, Machined and Cold Rolled.**

## "PETRO"

**FORGED STEEL**
**A.A.R. Design**
**Steel to Steel Seat**

SIZES ⅛" TO 3"




ILLUSTRATED IN EXACT SIZE ¾"

Clayton **MARK** & Company

*PIONEERS OF STEEL UNIONS SINCE 1912*

**Evanston, Illinois**

# ONE of FOUR

## Surface Condensers
## Totaling 122,000 Square Feet

Typical of larger surface condensers designed and built by Lummus is this 36,000 square foot unit for a well-known public utility. Precision workmanship in the Lummus Company plant will facilitate easy and accurate assembly in the field.

All Lummus condensers are equipped with air ejectors designed and built by Lummus.

**DESIGN FEATURES**
**LUMMUS SURFACE CONDENSERS**

- Streamlined Tube Layout
- Internal Air Cooling Section
- Deaerating Hotwell

**RESULTING IN —**

- Minimum Pressure Drop
- Minimum Condensate Depression
- Minimum Condensate Oxygen Content
- Minimum Air Ejector Steam Requirements

**THE LUMMUS COMPANY · 420 LEXINGTON AVE., NEW YORK, N.Y.**

# LUMMUS

## REMOVE HEAT WASTING SCALE MORE QUICKLY AND THOROUGHLY

Scarcity makes saving fuel more important than ever these days. As little as 1/32 of an inch of scale in tubes can increase fuel consumption as much as 10%. Such wasteful consumption in wartime should stop. Airetool Tube Cleaners can help you do this and will save you time and money as well.

You will find that Airetool Cleaners thoroughly remove deposits faster without tracking or damage to tubes. They are available for straight or bent tubes; ½" to 20" I.D. to meet every tube cleaning problem.

### MORE POWERFUL AIRETOOL MOTOR

Airetool's unique power seal motor gives 28% greater power, ample speed and can be loaded down to 50 rpm without stalling. Precision slip-fit construction of alloy steels assures longer life and easy maintenance.

### AIRETOOL TUBE EXPANDERS

Precision-made, long-lasting Airetool Tube Expanders are made for every size and type of tube. Special types for unusual conditions. Right angle or universal drives where the tube opening is hard to reach.

**AIRETOOL MANUFACTURING COMPANY**

**Write for Bulletin P-14**

**SPRINGFIELD, OHIO**

# Are you equipped to hold your job?—to get a new one?

**The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.**

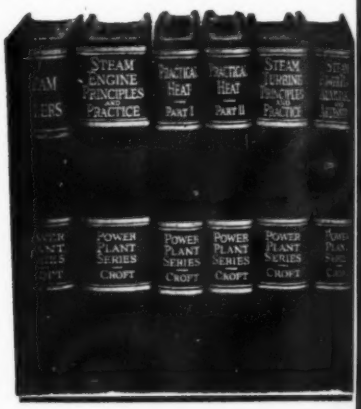
**It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.**

**How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?**

**Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our Free Examination Offer. Then send the attached coupon to us today.**

## POWER PLANT PRACTICE

**(6 volumes—2,477 pages, 2,404 illustrations)**




The Library of Power Plant Practice is the standard of the power plant field. It is accurate — it is thorough — it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field—nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day — more money in your pocket.

No books dealing with the work of the power plant man were ever so complete — so authoritative — so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him in language he can understand, all the information he needs in order to get ahead at his work.

### Easy to Understand

These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There is no bunkum in this Library, nor is it cluttered up with impractical theories. It is a Power Plant Library FOR POWER PLANT MEN.

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers Power Plant Practice. Here you have all the information necessary to make you indispensable on the job.

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# You Get

**INSTANT ACTION**

**POSITIVE CONTROL**

**LOWER UPKEEP**

**LONGER SERVICE**

## with HOMESTEAD *Quarter-Turn Valves*

**INSTANT ACTION** because a Quarter-Turn *fully opens* or *closes* these valves. They operate 16 to 28 times *faster* than screw-stem types.

**POSITIVE FLUID CONTROL** because cam presses seating surfaces firmly together in closed position, yet valve operates freely. Sealed bottom, bonnet and stem, prevent wasteful, outside leakage.

**LOWER UPKEEP AND LONGER SERVICE** because seating surfaces are protected in the closed position and turned completely out of the fluid path in the open position. Thus shielded from corrosion or erosion by fluids, longer life is assured.

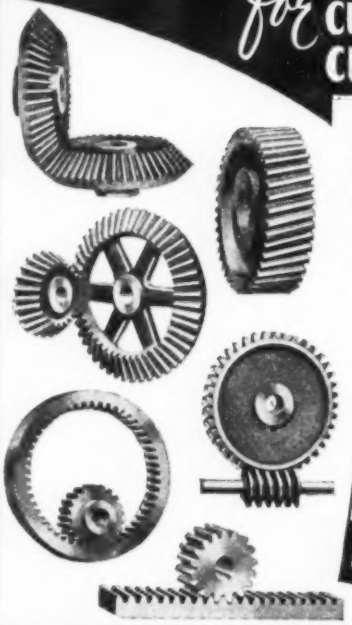
HOMESTEAD QUARTER-TURN VALVES are made in sizes, types and metals for most of your valve needs; for pressures to 3000 pounds and temperatures to 750 degrees F. Consult our engineering department for special valves designed to your own specifications. Write for copy of Valve Reference Book No. 38.

Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

**HOMESTEAD VALVE MFG. CO.**

P. O. BOX 210 CORAOPLIS, PENNSYLVANIA

You can depend upon "Industrial" for CUT GEARS CUT RACKS CUT SPROCKETS



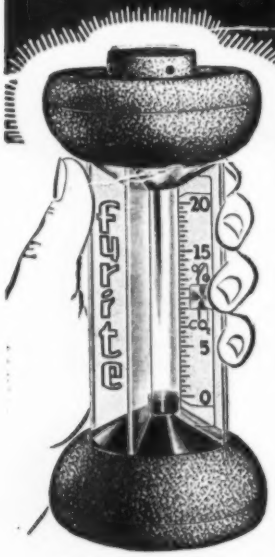
Our precision equipment, complete facilities and long experience are at your disposal to produce for you now.

*Your inquiries are invited.*

**INDUSTRIAL GEAR MFG. CO.**
4543 VAN BUREN STREET CHICAGO 24, ILLINOIS

ARE YOU WASTING *Precious Fuel Up the Stack?*

THE *PORTABLE* **FYRITE** $CO_2$ ANALYZER EXPOSES STACK LOSS *INSTANTLY!*




Getting all the heat possible from your fuel? *Be sure*—use the FYRITE "Orsat" $CO_2$ Analyzer. It makes accurate flue gas tests easy—instantly exposing percentage of fuel wasted. The FYRITE is simple, rugged, cold-weather proof—has no valves, clamps or leveling bottle; no glass parts or batteries. More than 8000 FYRITES are in service.

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RETURN THIS COUPON FOR BULLETIN 340 on *FYRITE "Orsat". Also learn how to get immediate delivery under priority regulations.*

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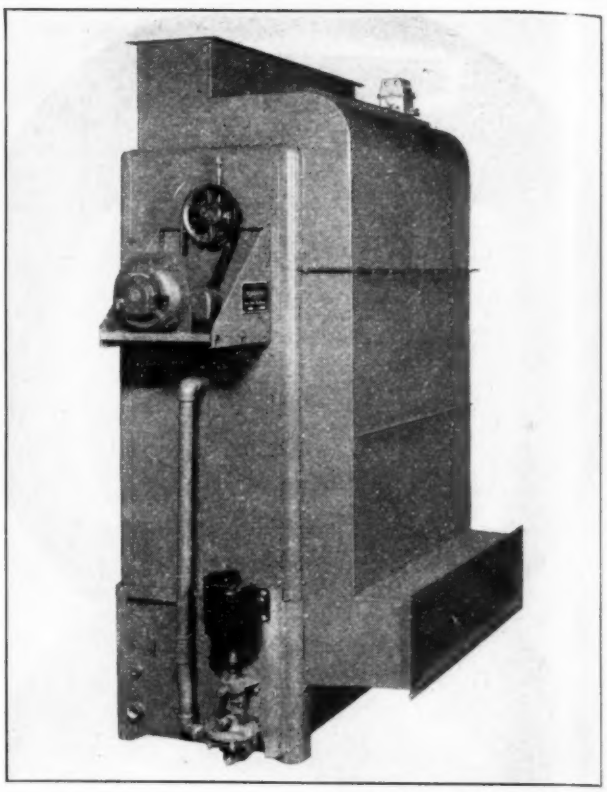

U. S. Patent Nos. 2,296,946 and 2,231,933

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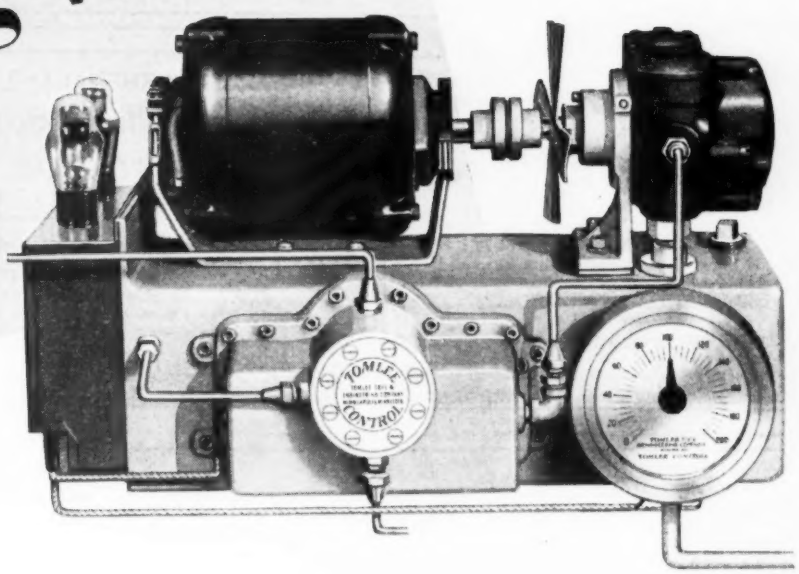
*HUMIDIFYING • AIR ENGINEERING EQUIPMENT*

# Reducing Valves MUST BE MADE MORE SENSITIVE



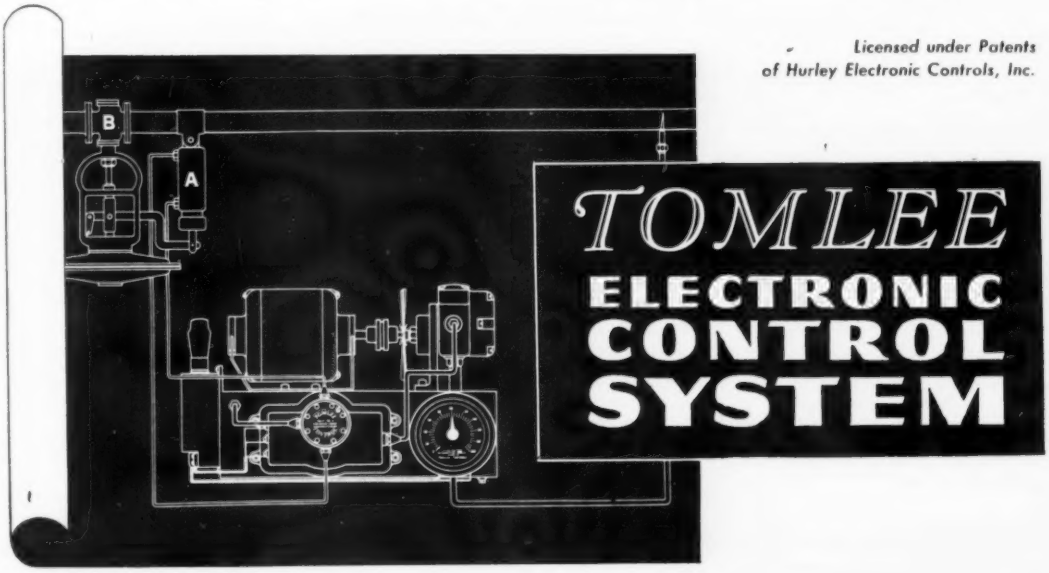

REDUCING VALVES have been serving industry well for many years. But under today's demands for closer and closer control, these sturdy monitors of the steam line need help to make them more sensitive . . . an electronic hand to make them respond instantly to changing impulses.

Balance of such an electronic hand is provided by the Tomlee Electronic Control System . . . a device so sensitive that it will record and correct minute variations in any pre-set value in milliseconds. By so doing, the Tomlee system eliminates "lag," avoids the accumulation of repeated errors that increase costs.

Use of the Tomlee Electronic Control System shows a very material saving in fuel cost. Connected in the line between an impulse tube and the reducing valve, it provides the infinite sensitivity demanded by modern operating cost requirements. This is accomplished by a combination of electronic, electrical, hydraulic and mechanical operations.

The Tomlee Electronic Control System is a simple compact unit . . . weighs but 50 pounds and is 12" x 15" x 20" in dimension. The schematic drawing (below) shows how easily and practically the Tomlee Control can be incorporated into your steam system. Full information will be sent on request. Write TOMLEE TOOL AND ENGINEERING COMPANY, 253 Third Avenue, South, Minneapolis (15), Minnesota.

*Licensed under Patents of Hurley Electronic Controls, Inc.*




Slight variations of pressure are transmitted to the Tomlee Electronic Control Unit by the impulse tube. These are converted into hydraulic impulses which actuate piston (A) which modulates reducing valve (B) in fractions of one-thousandth of an inch, thus maintaining any preset value with the utmost preciseness.

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GET MORE POWER FROM LESS FUEL

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**These low cost meters are easy to read. Simply subtract present reading from last reading, same as gas or rate meter. Quickly installed—easily maintained. Factory tested for accuracy within 1%. Standard in industrial plants, colleges, institutions and district heating companies.**

**Put your steam on an accounting basis. Write for quotations, advising us the maximum pounds of condensation per hour or the equivalent direct radiation in the building or department. Also ask for bulletin 35-80PR.**

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NORTH TONAWANDA, N.Y.
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*Reads Directly in Pounds of Steam Used*

ADSCO ROTARY CONDENSATION METER



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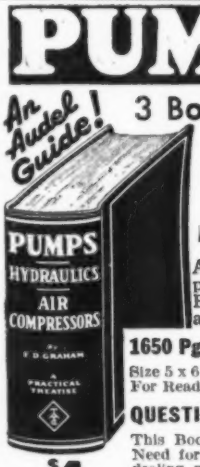


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MAIL AUDELS PUMPS, HYDRAULICS, AIR COMPRESSORS (Price $4) on 7 days free trial. If O.K., I will remit $1 in 7 days and $1 monthly until the $4 is paid. Otherwise I will return it.

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ENGINEER WANTED with "Chief's license in New Jersey to take charge of power plant and refrigerating system of a large meat packing house. Must have experience in packing house or kindred plant and be capable of looking after all maintenance work. Must be a citizen of U.S.A. Give full qualifications, education and experience in application. P-633, Power, 330 W. 42nd St., New York 18, N. Y.

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Vegetable oil processing plant in Southwest wants a young experienced Mechanical Engineer to supervise mechanical service departments, and another to do engineering development and design.

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In answering give full details as to experience and personal history in first letter.

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*We stock the Best of Insulation*
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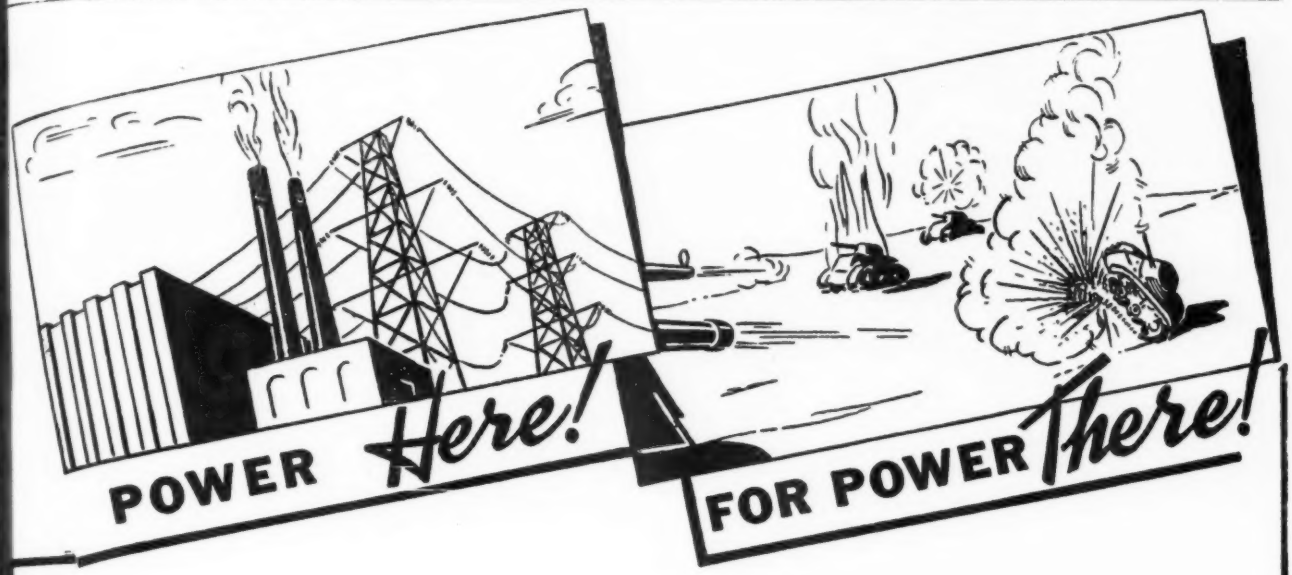


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1—3000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric squirrel cage induction motor.
1—6½ KW, 125 volt, General Electric, squirrel cage

## ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

## MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM Lincoln, 440 volt, slip ring
1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—350 HP, 360 RPM, 440 volt General Electric slip ring
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 1200 RPM, General Electric, squirrel cage.
1—150 HP, 900 RPM., 440 volt, Al. Ch. sl. rg.
1—150 HP, 600 RPM, 440 volt, G.E., sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

## INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT
25—Westinghouse type U Recording Volt-meters.

## MOTORS—3 PHASE 60 CYCLE (Con't)

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1—90 HP, 400 RPM, 550 volt, Cr. Whir., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach syn
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

## MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
2—20 HP, Westghse., 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

## TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—200 KVA, G.E., 2200/220/440.
3—150 KVA, G.E., 33,000/ 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
3—75 KVA General Electric, 2200/220/110
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, G.E., 2200/220/110.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
3—37½ KVA, G.E., 2200/220/440.
2—30 KVA Allis Chalmers, 3 phase, 4156Y/120/208Y
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

## MOTORS—VARIABLE SPEED 230 VOLTS

1—150 HP, 350/1050 RPM, Crocker-Wheeler.
2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

## TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 420 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.

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MOTOR GENERATOR SETS
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**Put all idle equipment to work. Send your list for prompt action.**

## TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
1—200 KVA, G.E., type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—150 KVA Pittsburgh, 2300/115/230 volts, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.

OTHER SIZES, VOLTAGES AND CYCLES AVAILABLE

## ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW Westh. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.

## D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.

## MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

125 K.W. Crocker Wheeler, 250 Volts D.C. Comp. WD. Dir. Con. To G.E. 2300 or 440 Volts Sq. Cage Motor

100 K.W. Gen. Elect. 3 BRG. 125 Volts D.C. Comp. WD. INT. with 220/440 Volts Sq. Cg. Motor.

100 K.W. Gen. Elect. 3 BRG. 230 Volts D.C. Comp. WD. INT. with 2300 Volts Sq. Cg. Motor.

## CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM
25 H.P.—Form E—550 Volts—760 RPM

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle, 750 speed, 220/230 volts. With Transformers for 2300 volts.

## FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ½ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543—3 ph. 25 cy. 220 volt 750 RPM.

**OTHERS IN ALL SIZES VOLTAGES AND CYCLES**

## 3 ph. 60 cy. A. C. MOTORS

| H.P. | Make | Type | | Speed | Volts |
|---|---|---|---|---|---|
| 250 | West | S.C. | C.S. | 900 | 440 |
| 200 | West | Syn. | .08 P. P. | 900 | 220/440 |
| | | WITH DIRECT CON. EXCITER | | | |
| 200 | Wsghse. | Sl. Rg. | CW | 600 | 220/440 |
| 200 | Gen. Elec. | Sq. Cg. | 1 Form K | 514 | 220/440 |
| 175 | Ideal | Sl. Rg. | AVA | 1750 | 2200 |
| 150 | Gen. Elec. | Sq. Cg. | I K | 600 | 2300 |
| 150 | Al Ch | Sq. Cg. | | 600 | 440 |
| 150 | Burke | Sq. Cg. | 3 BRG. 2 ph | 900 | 220/440 |
| 125 | Gen. Elec. | Sl. Rg. | MT. 553 | 1200 | 220 |
| 125 | Gen. Elec. | Sq. Cg. | I K | 720 | 220/440 |

## 3 ph. 25 cy. MOTORS

| H.P. | Make | Type | | Speed | Volts |
|---|---|---|---|---|---|
| 830 | Elect. Mach. | Syn. | Dir. Con. Exc. | 500 | 2300 |
| 350 | Gen. Elec. | Sl. Rg. 3 Brg. | I | 375 | 440 |
| 250 | Gen. Elec. | Sl. Rg. 3 Brg. | I | 500 | 440 |
| 200 | Lincoln | S. R. | I. X. W. | 500 | 440 |
| 150 | Burke | Syn. | Dir. Con. Exc. | 500 | 440 |
| 150 | Gen. Elec. | Sl. Rg. | I Form M | 500 | 2200 |
| 100 | Wagner | Sl. Rr. | BR | 750 | 220/440 |
| 100 | Gen. Elec. | Sl. Rg. | I Form M | 750 | 220/440 |
| 100 | Gen. Elec. | Sq. C. | I K | 750 | 220/440 |
| 100 | Wsghse. | Sq. C. | CS | 500 | 20/440 |
| 75 | Wsghse. | Sq. C. | CCL | 500 | 220/440 |
| 75 | Gen. Elec. | Sl. Rg. | I M | 750 | 220/440 |
| 75 | Wagner | Sq. C. | BM | 750 | 2200 |
| 75 | Gen. Elec. | Var. | BTA | 375/750 | 440 |
| 50 | Burke | Syn. | AC133 | 750 | 220 |
| | | WITH DIRECT CON. EXCITER | | | |

## 230V D. C. MOTORS

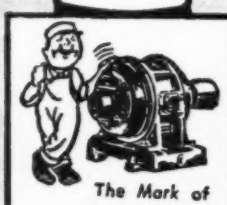
| H.P. | Make | Type | Speed |
|---|---|---|---|
| 150 | West | SK180L Comp. Wd. Int. | 1150 |
| 125 | G.E. | CL | 850 |
| 100 | Northwestern | K30 Comp. Inter. | 1750 |
| 85 | Gen. Elec. | Vert. Comp. Wound | 700 |
| 75 | Crocker Wh. | CCM25JA | 1700 |
| 67 | Otis | Elevator Motor Comp. wd. | 1200 |
| 60 | Sprague | D—Comp. Wound | 625 |
| 50 | Gen. Elec. | C. L. 6 Shunt Wound | 560 |
| 40 | Fair. Morse | Ball BRG. Vert. Comp. | 1740 |
| 32 | Sturdevant | C Form P. Shunt Wound | 190 |

*Only partial listing*

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO
REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

*Write or wire your inquiries*

**BERGER BROTHERS**
**ELECTRIC MOTORS, Inc.**
395 STATE ST.
ROCHESTER NEW YORK




**THE FRED W.**
**KIEMLE CO.**
33 N. SUPERIOR ST.
TOLEDO OHIO

# ELECTRICAL POWER EQUIPMENT

## TURBO GENERATORS

**3 Phase, 60 Cycle**

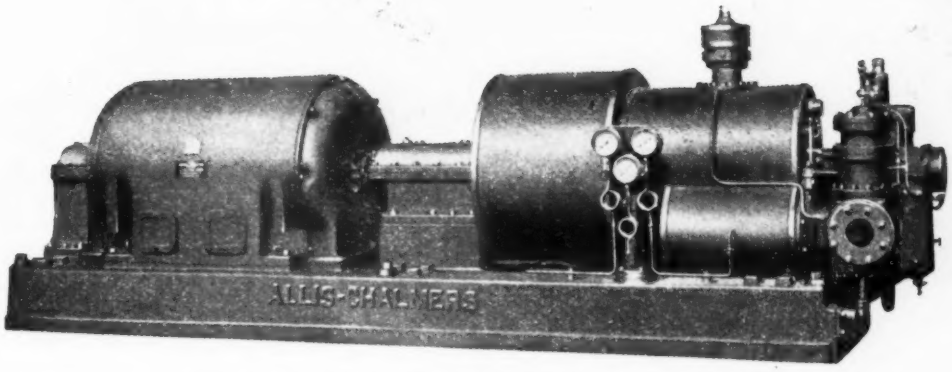
6000 KVA WESTINGHOUSE 250-400 lbs. 2300 volts, with surface condenser.

2500 KVA WESTINGHOUSE non-condensing, 250-400 lbs., 2300 volts.

1875 KVA GENERAL ELECTRIC 150-200 lbs. 2300 volts with surface condenser.

## SURFACE CONDENSER

1540 sq. ft. WORTHINGTON surface condenser with steam jet air pumps.




**1250 KVA ALLIS CHALMERS CONDENSING TURBO UNIT**

*1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.*

## MOTOR GENERATORS

**3 Phase, 60 Cycle**

1500 KW WESTINGHOUSE synchronous 250 volts D.C., 11000/4000 volts A.C., 360 RPM.

1000 KW GENERAL ELECTRIC 3-UNIT synchronous 125/250 volts D.C., 4000/2300 volts A.C., 720 RPM.

800 KW WESTINGHOUSE synchronous 125/250 volts, 3-wire D.C., 13200 volts A.C., 514 RPM.

500 KW GENERAL ELECTRIC synchronous 700 volts D.C., 4150 volts A.C., 720 RPM (Full Automatic).

## ENGINE GENERATORS

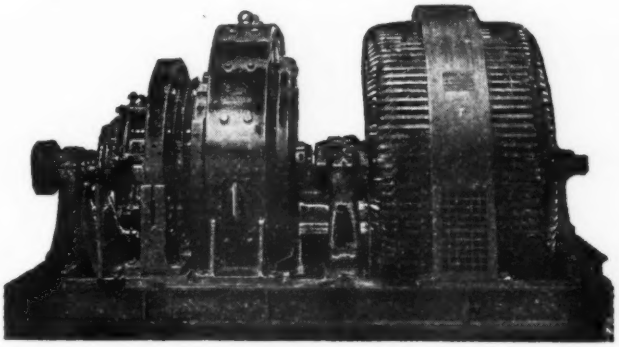
**3 Phase, 60 Cycle**

675 KVA ELECTRIC MACHINERY-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts 150 RPM.

438 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts.

340 KVA WESTINGHOUSE SKINNER uniflow, 150 lbs., 5 lbs. back pressure, 240/480/2300 volts, 200 RPM.

210 KVA GENERAL ELECTRIC SKINNER uniflow, 150 lbs., 5 lbs. back pressure, 240/480 2300 volts, 225 RPM.



*Actual Photograph*

**1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET**

*1000 KW (1250 KW 2 hrs. 55 deg. C rise) GENERAL ELECTRIC direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1400 HP 80% P.F. (1750 HP 2 hours 55 deg. C. rise) GENERAL ELECTRIC synchronous motor 3 phase 60 cycle 13200/6600 volts 720 RPM. Equipped with D.C. breakers.*

## ENGINE GENERATORS
## 250 Volts D.C.

500 CROCKER-WHEELER-AMES 4 cylinder vertical uniflow, 150 lbs., 5 lbs. back pressure.

250 KW CROCKER WHEELER-SKINNER uniflow, 115 lbs. 3 lbs. back pressure.

## ROTARY CONVERTERS

**3 Phase, 60 Cycle**

3500 KW (2) WESTINGHOUSE 225-285 volts D.C., 225 RPM, with 13200 volt transformers.

2600 KW (2) GENERAL ELECTRIC booster, 250/300 volts D.C., 300 RPM, with 5040/210 volt transformers.

1700 KW (2) GENERAL ELECTRIC 250 volts D.C., 514 RPM.

1500 KW GENERAL ELECTRIC synchronous 275 volts D.C., 2200/4400 volts A. C., 360 RPM.

1150 KW GENERAL ELECTRIC 250 volts D.C., 720 RPM.

750 KW GENERAL ELECTRIC 600 volts D.C., 1200 RPM. with 2300/4000 volt transformers.

**3 Phase, 25 Cycle**

2000 KW WESTINGHOUSE 270 volts D.C., 300 RPM, with 9000 volt transformer.

## DIESEL GENERATORS

**3 Phase, 60 Cycle**

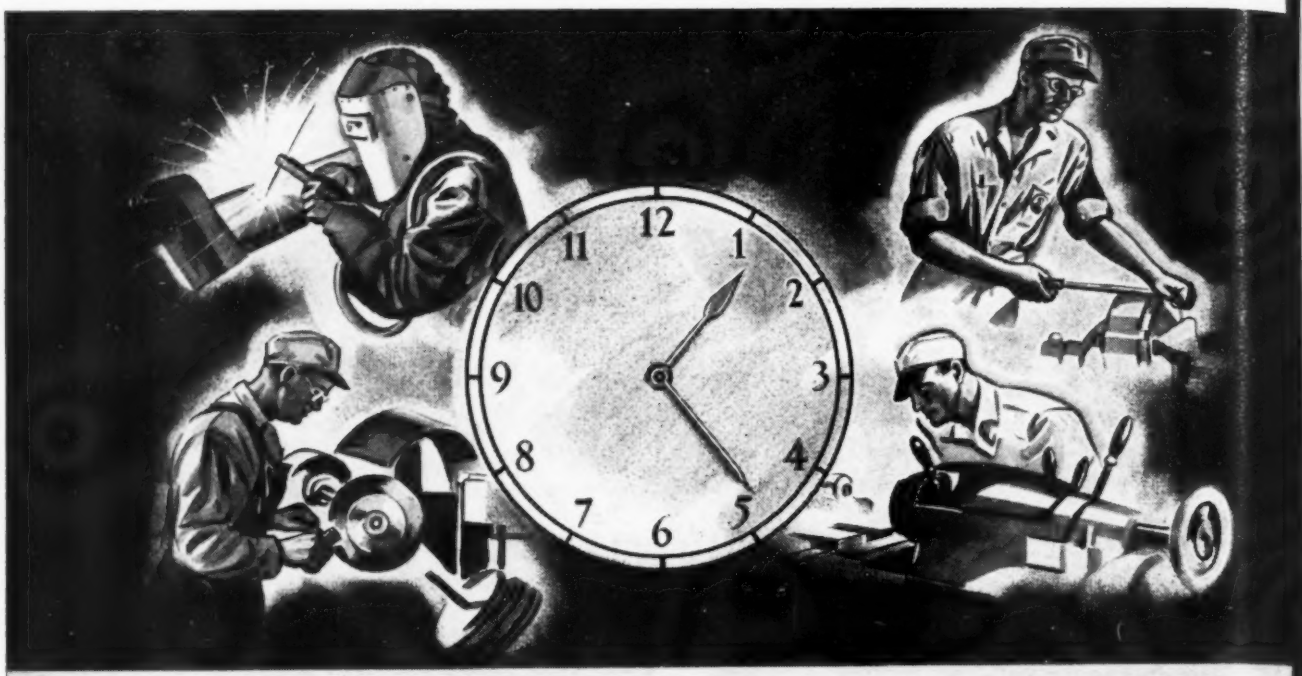
375 KVA WESTINGHOUSE BUSCH-SULZER 8 cylinder 2400 volts, 300 RPM.

225 KVA WESTINGHOUSE WORTHINGTON 3 cylinder, 2300 volts, 275 RPM.

125 KVA WESTERN ELECTRIC WORTHINGTON 2 cylinder, 2300 volts, 277 RPM.

108 KVA GENERAL ELECTRIC BUSCH-SULZER 4 cylinder, 2300 volts, 276 RPM.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON ROAD CLEVELAND, OHIO



# WE'VE WORKED "'ROUND THE CLOCK" BEFORE

## ...and we can do it again for *you*...if necessary

WHEN time is working against you and machine deliveries threaten to bottleneck operations, let O'Brien "round the clock" service put you back on schedule.

Here's one example. A troop transport was leaving New York harbor on a specific date. A 75 KW special motor generator set had to be converted from 230 volt to 125 volt and delivered to the ship before it sailed. Nothing was obtainable to meet the specifications but—they called on The O'Brien Machinery Company for help. Here's how the problem was worked out. O'Brien men worked "round the clock". A generator was taken off one set in the O'Brien stock, a motor from another. A suitable base was made and all of the equipment was rebuilt and delivered to the ship in six days.

You may not need such service today or ever. You can never tell. But it's just one additional reason for depending on O'Brien. Remember it. Remember, too, that O'Brien rebuilt means okay in every way and guaranteed.

### MOTOR GENERATOR SETS

1—250 K.W. General Electric MPC, 230 V., 400 H.P. Synchronous 3/60/2300/1200 RPM
1—200 K.W. Crocker Wheeler 240 volt 900 RPM Synchronous 2/60/2300/900 RPM
1—100 K.W. Crocker Wheeler 250 V., 1200 RPM Syr. 3/60/440
1—94 K.W. G.E. type MPC 1600 Ampere 60 volt 1200 RPM, 150 H.P. G.E. Type IK Motor 3/60/220/440/2300/1200 RPM.
1—75 K.W. General Elec. 250 V Squirrel Cage 3/60/440/1200
1—50 K.W. G.E. 125 V. 720 RPM Squirrel Cage 3/60/2300
1—50 K.W. Westinghouse 125 V. Synchronous 3/60/440/1200
1—10 KW Crocker-Wheeler Balancer Set 125 volt.
1—5 K.W. General Electric 125 V. 3/60/220/440/1800
1—3.6 K.W. Eager 600 Amp. 6 volt 300 Amp. 12 volt 3/60/220
2—188 K.W. General Electric 3 unit M.G. Sets consisting of 2—94 K.W. General Electric Type MPC 1600 Ampere 60 volt Interpole Generators, 1150 RPM with direct connected 320 H.P. G.E. type MPC 240 volt 1200 RPM D.C. Motors or with 3 phase Synchronous. In Warehouse Stock
1—94 K.W. G.E. type MPC 1600 Ampere 60 volt 1200 RPM 150 H.P. G.E. Type IK Motor 3/60/220/440/2300/1200 RPM
1—25 K.W. Westinghouse SK 500 Ampere 50 volt 1800 RPM 40 H.P. 3/60/220/440/1800 RPM.

### STEAM TURBINE GENERATOR SETS

**Condensing—A.C.**

2—5000 K.W. Westinghouse 3/60/2300/3600 RPM.
2—5000 K.W. G.E. 3/60/2300/3000 RPM.
1—4000 KVA Allis Chalmers 3/60/2300/3600 RPM
1—3125 KVA Gen. Elec. 3/60/2300/3600 RPM
1—1560 KVA Westinghouse Bleeder 3/60/480
1—1500 KVA Westinghouse 3/60/2300/3600 RPM
1—750 K.W. Allis Chalmers 3/60/480/3600
1—625 K.W. Allis Chalmers 3/60/480/3600
1—500 KVA West. Geared, 3/60/2400/6000—900 RPM
3—500 KVA Gen. Elec. Bleeder 3/60/220/3600 RPM
1—250 KVA Worthington Moore Bleeder 3/60/220
1—187 KVA Westinghouse geared 3/60/2300
1—150 KVA Westinghouse 3/60/240/3600 RPM
1—375 KVA Westinghouse geared 3/60/2300
1—375 KVA Allis Chalmers 3/60/240/3600 RPM
1—75 KVA Allis-Chalmers 3/60/240/3600 RPM

New 1929 . . . used 3 months, 500 KVA Westinghouse Turbo Non-Condensing Generator. 3/60/480 Volt Geared 6000/900 RPM. 150 lb. ISP 5 lb. B.P. direct connected exciter, all accessories on foundation Phila. Desire to move by January 15. Prints, specifications on request—subject prior sale.

*Everything from a Pulley to a Power House*

# THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

113 NORTH THIRD STREET • PHILADELPHIA 6, PENNA.

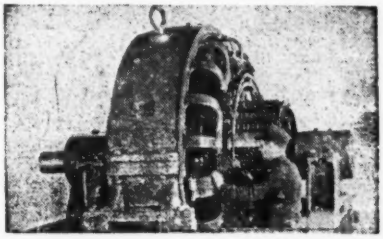
WAREHOUSES AND SHOPS—2820 EAST TIOGA STREET . . . 1224 NORTH FRONT STREET . . . 5534 HAVERFORD AVENUE

BELL TELEPHONE: MARKET 4180 CABLE ADDRESS: OBRIEN PHILA

# Step Up Your Power

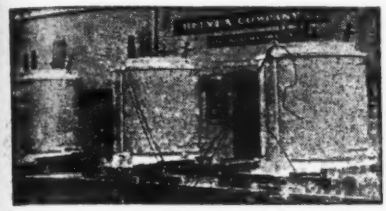
## QUICK WITH

# Stock Equipment



***Shipped as fast as conditions allow***

**WRITE—Better Still—WIRE**



### MOTOR GENERATOR SETS

**3 Phase 60 Cycle**

1—1000 KW G.E., 600 V. D.C. to 1400 H.P. 4000 V.

1—1000 KW WHSE., 600 V. D.C. to 1400 H.P. 4000 V.

1—500 KW 3 unit consisting of 2—250 KW G.E., 250 V., d.c., to 1—700 HP, 2300 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.

1—500 KW G.E., 250 V. D.C. to 1000 KVA, 2200 V. Syn. Motor.

1—400 KW G.E., 250/275 V., D.C. to 600 HP, 2300 V.

1—300 KW G.E., 250/275 V. D.C. to 400 KVA 440 V.

1—260 KW 3 unit consisting of 2—130 KW G.E., 75 V. D.C. to 600 KVA 220/440 V.

1—100 KW WHSE., 250 V. D.C. to 159 KVA, 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg. 2300/4000 V.

3—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

### TURBO GENERATOR SETS

1—500 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

### A. C. GENERATORS AND SYNO. MOTORS

**3 Phase—60 Cycle**

| HP or KVA | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 1—1000 | Whse. | | 2300 | 900 |
| 1— 750 | G.E. | ATI | 220/440 | 900 |
| 1— 600 | G.E. | ATI | 220/440 | 900 |
| 1— 625 | Whse. | | 480 | 900 |
| 1— 500 | G.E. | TS | 440 | 360 |
| 1— 250 | G.E. | ATB | 2300 | 600 |
| 1— 225 | G.E. | ATB | 220 | 600 |
| 1— 159 | Whse. | | 2400 | 900 |
| 1— 150 | Whse | | 4000 | 1800 |
| 1— 100 | Whse. | | 2400 | 900 |
| 2— 100 | Whse. | | 2300 | 1800 |

### A. C. MOTORS

**3 Phase—60 Cycle**

**SLIP RING**

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 1—1200 | Cr. Wh. | 801Q | 2300 | 257 |
| 1— 800 | Al. Ch. | ANY | 440 | 885 |
| 1— 800 | Whse. | CW | 440 | 357 |
| 2— 600 | G.E. | IP | 440/2200 | 720 |
| 1— 600 | G.E. | IM | 440 | 900 |
| 1— 450 | Whse. | HW | 2200 | 875 |
| 1— 400 | Al. Ch. | ANY | 440 | 1200 |
| 1— 400 | G.E. | MT | 550/440 | 300 |
| 1— 400 | Al. Ch. | ANY | 2300 | 505 |
| 1— 400 | G.E. | IP | 440/2200 | 600 |
| 1— 350 | G.E. | MT-442 | 2300/4000 | 257 |
| 1— 300 | G.E | IM | 440 | 720 |
| 1— 300 | Whse. | CW | 440 | 585 |
| 1— 250 | G.E. | MT | 4000/2300 | 257 |
| 1— 200 | G.E. | IP-M | 2200 | 1750 |
| 1— 200 | Whse. | CW | 2200 | 514 |
| 1— 200 | G.E | I-M | 440 | 600 |
| 1— 150 | G.E. | IM | 2200 | 695 |
| 1— 150 | G.E. | MT-564 | 440 | 600 |
| 1— 150 | G.E. | IM-17B | 2200 | 290 |
| 1— 100 | G.E. | IM | 220 | 1750 |

### A. C. MOTORS

**SQUIRREL CAGE**

| H.P. | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 1—500 | G.E. | 1-17B | 2200 | 690 |
| 1—400 | Whse. | CS-1104A | 2200 | 585 |
| 1—300 | Whse. | CS | 550 | 580 |
| 1—300 | G.E. | IK | 440/2300 | 600 |
| 1—200 | G.E. | IK | 2300 | 490 |
| 4—175 | G.E. | IK | 440 | 900 |
| 1—150 | Lincoln | | 440 | 1200 |
| 1—150 | G.E. | IE | 440 | 1200 |
| 1—150 | Al. Ch. | AN | 440 | 1765 |
| 1—100 | Whse. | CS | 550 | 1750 |

### GEAR REDUCTION UNITS

1—2100 H.P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5306/1200 RPM.
1— 750 H.P. Al. Ch. 3600/600 RPM.
1— 450 H.P. G.E. 3600/1200 RPM.

***THE BELYEA REPUTATION PROTECTS YOU!***

### ROTARY CONVERTERS

**3 Phase, 60 Cycle**

| Qu. | KW | Make | Speed | DC V. | Trans. V. |
|---|---|---|---|---|---|
| 1 | 1500 | Whse. | 720 | 600 | 2300 |
| 1 | 1500 | Whse. | 600 | 600 | 11500 |
| 1 | 1250 | G.E. | 720 | 250 | 2300 |
| 1 | 1000 | G.E. | 900 | 600 | 13200 |
| 1 | 1000 | Whse. | 900 | 600 | 11000 |
| 2 | 750 | G.E. | 1200 | 600 | 2300 |
| 1 | 750 | Whse. | 720 | 250 | 6600/2300 |
| 1 | 500 | Whse. | 1200 | 600 | 13200/2300 |
| 2 | 375 | G.E. | 1200 | 250 | 6600/2300 |
| 3 | 300 | G.E. | 1200 | 600 | 2300 |

**3 Phase, 25 Cycle Booster Type**

| | | | | | |
|---|---|---|---|---|---|
| 2 | 1500 | G.E. | 500 | 225/275 | 13200/6600 |
| 1 | 500 | G.E. | 750 | 225/275 | 13200/6600 |

All units can be furnished with AC and DC controls

### TRANSFORMERS

**60 Cycle**

| KVA | Make | Ph. | Type | Voltages |
|---|---|---|---|---|
| 6—1667 | Pitts | 1 | OISC | 13200x2300 |
| 4— 525 | G.E. | 1 | HJ-DD | 2300x445 |
| 3— 333 | Maloney | 1 | OISC | 22000/11000x2300/575 |
| 2— 333 | Whse. | 1 | OISC | 2300x460 |
| 2— 333 | Pitts. | 1 | OISC | 2400x220 |
| 3— 300 | G.E. | 1 | H | 13200x2300/575 |
| 2— 200 | G.E. | 1 | HILD | 26400x115/460 |
| 3— 200 | G.E. | 1 | H-KDD | 13800x220/440 |
| 3— 150 | Whse. | 1 | SK | 2200x440/220 |
| 3— 150 | Whse. | 1 | SKM | 2400x120/240 |
| 6— 100 | Whse. | 1 | SK | 6900x460/230 |
| 3— 100 | Whse. | 1 | OISC | 13200x250 |

### D. C. MOTORS

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 1—1250 | G.E. | MCF | 250 | 650 |
| 2—1250 | G.E. | MPC | 500 | 130 |
| 1— 800 | G.E. | MPC | 550 | 600 |
| 2— 625 | G.E. | MPC | 250 | 130 |
| 2— 600 | G.E. | MPC | 550 | 600/800 |
| 1—500 | G.E. | MPC | 230 | 900 |
| 1—400 | G.E. | MPC | 230 | 900 |
| 1— 350 | G.E. | MPC | 230 | 450 |
| 1— 300 | G.E. | MCF | 230 | 400/100 |
| 2— 300 | G.E. | DMC | 230 | 400/600 |
| 2— 300 | Whse. | | 500 | 250/400 |
| 1— 300 | G.E. | MPC | 230 | 275/550 |
| 1— 300 | G.E. | MPC | 230 | 250/440 |
| 1— 250 | Al. Ch. | Irt | 230 | 525 |
| 2— 200 | Whse. | | 230 | 400/500 |
| 1— 175 | Whse. | SK | 250 | 150/625 |
| 1— 150 | G.E. | RC-19 | 230 | 800/1000 |
| 1— 150 | Whse. | SK | 230 | 300/900 |
| 2— 125 | G.E. | CO-1832 | 230 | 625 |
| 2— 120 | Whse. | SK | 230 | 720 |
| 1— 100 | Al. Ch. | | 230 | 950/1150 |
| 3— 100 | G.E. | LC | 230 | 1200 |
| 1— 100 | G.E. | MPC | 230 | 225/450 |
| 1— 100 | Whse. | SK | 230 | 600 |
| 2— 100 | G.E. | RC-19 | 230 | 575/720 |
| 1— 75 | G.E. | C | 230 | 500/100 |
| 3— 70 | Whse. | SK-183 | 230 | 560/780 |
| 4— 60 | Diehl | K-11 | 230 | 500/1000 |
| 2— 60 | Cr. Wh. | CMC-65H | 230 | 500/1000 |
| 1— 50 | Cr. Wh. | CMC-81H | 230 | 300/900 |
| 1— 50 | Cr. Wh. | CMC-80H | 230 | 380/750 |
| 10— 50 | G.E. | RF-16 | 230 | 400/1600 |

RE-NU-BILT BELYEA MOTORS

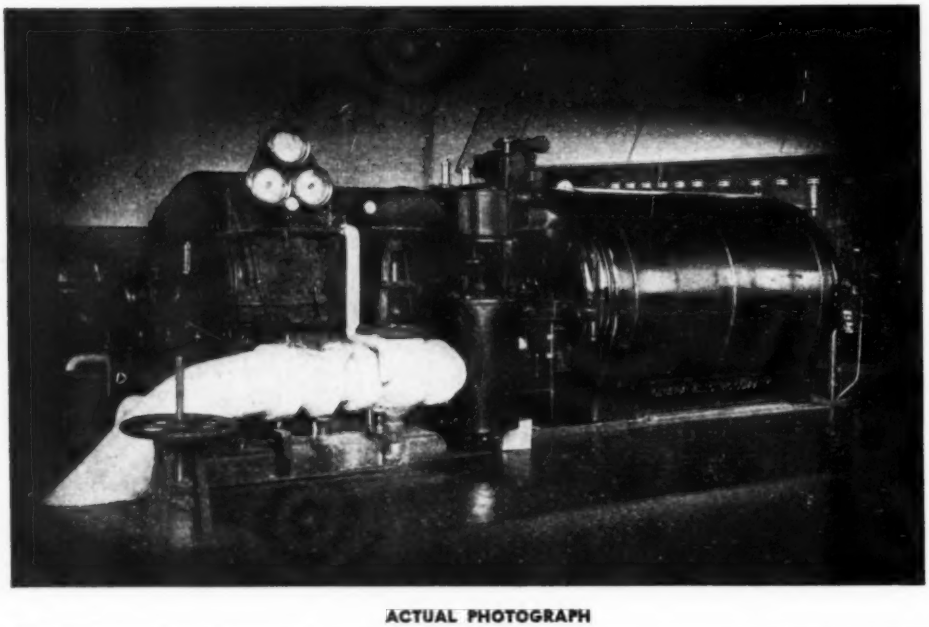
**SUCCESSFUL OPERATION GUARANTEED**

# BELYEA

**COMPANY INC.**

***Main Office & Shop:* 43 HOWELL ST., JERSEY CITY, N. J.**

# 3125 KVA CONDENSING TURBINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

## AVAILABLE IMMEDIATE DELIVERY

**3125 KVA — 2500 KW 80% P.F. General Electric, 3 phase, 60 cycle, 2300 volt, 3600 RPM condensing turbine-generator unit, 180-200# I.S.P., 500° T.T., equipped with surface condenser, panels and instruments.**

**Excellent condition—a complete installation.**

### TURBINE-GENERATOR UNITS

**3 phase, 60 cycle**

7500 KVA Westinghouse condensing 200 lb. pressure, 2300 volts, 1800 RPM complete with either surface or jet condenser.

6250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser.

3125 KVA—2500 KW 80% P.F., G.E. 2300 volts, 3600 RPM, 180-200 lbs. pressure, 500 degree total temperature, equipped with surface condenser, condensing auxiliaries, panels and instruments. A complete installation.

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937 KVA Allis condensing 150-200 lb. pressure, 475° T.T., 2300 volts, 3600 RPM complete with direct connected exciter, surface condenser and auxiliaries.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb.. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

### ENGINE-GENERATOR UNITS

**Direct Current**

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14" x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgway Unaflow non-condensing engine.

300 KW Westinghouse, 250 volts, 175 RPM generator direct connected to a 24" x 26" Skinner Unaflow non-condensing engine.

150 KW General Electric, 240 volts, 200 RPM generator direct connected to Ames Unaflow non-condensing engine.

### ROTARY CONVERTERS

1500 KW Westinghouse synchronous 250 volts, direct current—6 phase, 60 cycle alternating current, 514 RPM.

750 KW (2) G.E. synchronous, 600 volts direct current, 6 phase, 60 cycle alternating current, 1200 RPM.

330 KW G.E. synchronous, 600 volt direct current, 6 phase 60 cycle alternating current, 1200 RPM with 2300 to 408 volt transformers.

### ENGINE-GENERATOR UNITS

**3 phase, 60 cycle—**

**Alternating Current**

312 KVA G.E. 2300/480 or 240 volt, 200 RPM generator direct connected to a Chuse 4-valve non-releasing Corliss engine.

312 KVA Elliott 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

75 KW 80% P. F., Elliott 480 volts, 225 RPM generator direct connected Elliott 4-valve engine.

### MOTORS

**—3 phase, 60 cycle**

250 HP (2) G.E. form M, 440 volts, 450 RPM three-bearing slip ring.

150 HP (5) G.E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy, 440 volts, 400 RPM synchronous.

50 HP G. E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

### MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

### SPECIALS

2000 KVA G.E. 3 phase, 60 cycle, 480 volt, 300 RPM alternating current generator.

750 HP, 28" x 32" Skinner, 150 RPM Unaflow belted type engine, 125 to 155 lb. pressure at throttle, 20 to 30 lb. gauge back pressure.

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters —a complete installation—modern and practically new.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

165 KW Electric Machinery 3 phase, 60 cycle, 2400 volt, 514 RPM belted generator.

### SYNCHRONOUS CONDENSERS

**1350 KVA**

**Total Capacity**

750 KVA and 600 KVA G.E. type ATI, 3 phase, 60 cycle, 240 volts, 900 RPM synchronous condensers each complete with direct connected exciter, switchboard panel with instruments. Are in A#1 operative condition — still on original foundation for operating test.

**Utilities Electrical Machinery Corporation**

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

# REBUILT POWER EQUIPMENT *READY TO SHIP!*

## ROTARY CONVERTER

2—400 KW, G.E., 250 v. 600 rpm., 2300/3/60 A.C.

## MOTOR GENERATOR SETS

1—150 kw. Crocker Wheeler 250 v. DC. 600 rpm. dir. con. to 220/440 or 2200 v. syn motor.

125 kw. Cr. Wh. 250 v. D.C. 1200 rpm., 220/440 v. 3 ph. 60 cy. Ind.

## ENGINE GENERATOR SETS

225 kw. Elec. Machy 2200 or 220 v. 2 ph. 60 cy. dir. con. Ideal Steam.

1—225 kw. Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 200 rpm. dir. con. Ideal Engine 4 valve non-releasing.

## 100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450 per min. direct driven by 100 hp. A.C. or D.C. Motor.

## A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)

1—150 kva. Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.

1—250 KW 480 V. 3/60, Allis-Chalmers, 150 rpm.

1—40 KW West., 220 v., 3 ph., 60 cy., 1200 rpm.

1—62½ KW West., 2300 v. (can be reconnected for 220/440 v.), 3 ph., 60 cy., 1200 rpm.

## A.C. MOTORS—3 ph. 60 cy.

| Qu. | HP | Make | Volts | Speed | Type |
|---|---|---|---|---|---|
| 18 | ½ | G.E. | 220 | 900 | K |
| 33 | ¾ | G.E. | 220 | 1140 | K |
| 19 | 1½ | Ilg. | 220 | 490 | |
| 12 | 3 | Louis Allis | 220/440 | 1200 | OK |
| 1 | 7½ | Louis Allis | 220/440-170/1750 | | F.S.—(Adjusto speed clutch motor constant torque |
| 1 | 40 | G.E. | 220/440/550 | 1200 | I-8 |
| 1 | 40 | West. | 440 | 900 | C |
| 1 | 40 | W. El. | 440 | 720 | CS |
| 2 | 40 | West. | 220 | 600 | —— |
| 2 | 40 | West. | 220 | 514 | CS |
| 1 | 40 | Am. El. | 440 | 685 | —— |
| | | (Vertical-ball bearing) | | | |
| 2 | 40 | Am. El. | 440 | 685 | PK |
| | | (Enclosed-ball bearing) | | | |
| 1 | 40 | West. | 220 | 600 | CS |
| 2 | 40 | West. | 440 | 1800 | MS |
| 1 | 40 | G.E. | 220/440 | 1160 | K |
| 1 | 40 | Triumph | 440 | 860 | 13-12 |
| 1 | 40 | G.E. | 440 | 860 | KT |
| 1 | 50 | Chandeys. | 220/440 | 1800 | —— |
| 1 | 50 | Al. Ch. | 220 | 1200 | —— |
| 1 | 50 | G.E. | 440 | 1200 | KT |
| 1 | 50 | Triumph | 440 | 1200 | B-12 |
| 1 | 50 | G.E. | 440 only | 1200 | I |
| 3 | 50 | A.E.C. | 440 | 900 | PK-enclosed |
| 1 | 50 | A.E.C. | 440 | 900 | vertical |
| 3 | 50 | West. | 220 | 720 | —— |
| 1 | 50 | West. | 220 | 514 | CS |
| 1 | 50 | Reliance | 440 | 1200 | —— |
| 7 | 50 | Al. Ch. | 440 | 1800 | AN |
| 2 | 50 | West. | 440 | 1800 | C |
| 1 | 50 | West. | 440 | 1120 | C |

## A.C. MOTORS—3 ph. 60 cy.—con't

| No. | Hp. | Make | Volts | RPM | Type |
|---|---|---|---|---|---|
| 1 | 50 | G.E. | 440 | 900 | I-8 |
| 3 | 50 | Wagner | 440 | 850 | —— |
| 1 | 50 | West. | 440 | 850 | CCL |
| 1 | 50 | West. | 440 | 650 | CCL |
| 2 | 50 | West. | 220 | 600 | CS-752C |
| 1 | 50 | G.E. | 220/440 | 1200 | HI |
| 1 | 50 | West. | 440 | 690 | C |
| 1 | 50 | G.E. | 220/440 | 450 | I |
| 1 | 50 | G.E. | 220/440 | 400 | I |
| 1 | 50/60 | West. | 440 only | 1800 | MS |
| 1 | 50/60 | G.E. | 440 | 1200 | I |
| 1 | 50/100 | West. | 440 | 345/700 | CS |
| 1 | 54 | Al. Ch. | 440 | 900 | —— |
| 1 | 60 | Al. Ch. | 440 | 1200 | —— |
| 1 | 60 | West. | 440 | 900 | C |
| 2 | 60 | West. | 220 | 720 | CS |
| 2 | 60 | G.E. | 550 | 660 | I-10 |
| 2 | 60 | Triumph | 220 | 430 | C16 |
| 6 | 60 | Al. Ch. | 440 | 1800 | AN |
| 1 | 60 | G.E. | 220 | 720 | I-8 |
| 1 | 60 | Cr. Wh. | 220 | 670 | 122Q |
| 6 | 65 | Al. Ch. | 440 | 1800 | AN |
| 3 | 65 | G.E. | 440 | 1800 | KT-347 |
| 1 | 75 | W. El. | 440 | 1800 | CS |
| 1 | 75 | Wagner | 140 | 1800 | —— |
| 4 | 75 | Al. Ch. | 440 | 1800 | AN |
| 1 | 75 | West. | 440 | 1200 | MS |
| 1 | 75 | G.E. | 220/440 | 1150 | I-8 |
| 1 | 75 | U.S.Mtr. | 220/440 | 900 | SC |
| 1 | 75 | West. | 220 | 600 | CS |
| 1 | 75 | G.E. | 220 | 900 | I-8 |
| 1 | 75 | G.E. | 440/550 | 720 | I-10 |
| 1 | 75 | Cr. Wh. | 220 | 514 | 124Q |
| 1 | 100 | U.S.Mtr. | 220/440 | 1160 | SC |
| 2 | 100 | G.E. | 550 | 900 | I-10 |
| 1 | 100 | West. | 220 | 720 | CS |
| 1 | 100 | G.E. | 2200 | 450 | I |
| 1 | 100 | West. | 220 | 1750 | —— |
| 1 | 100 | G.E. | 220 | 1200 | I-8 |
| 1 | 100 | Al. Ch. | 220 | 600 | —— |
| 1 | 100 | Cr. Wh. | 220 | 575 | 124QB |
| 1 | 100 | G.E. | 440 | 400 | I-K |
| 2 | 100 | West. | 220 | 1200 | CS-Vertical |
| 1 | 100 | West. | 240 | 900 | —— |
| 1 | 100 | G.E. | 2300 | 580 | I-15 |
| 1 | 125 | West. | 2300 | 1170 | CS |
| 1 | 125 | G.E. | 440 | 514 | I |
| 1 | 125 | G.E. | 440 | 450 | I |
| 1 | 125 | G.E. | 220/550 | 400 | I |
| 1 | 125 | Wagner | 440 | 1800 | —— |
| 1 | 125 | Cr. Wh. | 220 | 720 | 124QR |
| 1 | 125 | Al. Ch. | 2200 | 1165 | ARV |
| 1 | 150 | West. | 2200 | 720 | —— |
| 1 | 150 | G.E. | 220/550 | 514 | I |
| 1 | 150 | G.E. | 440 | 600 | I |
| 1 | 150 | G.E. | 440 | 514 | I |
| 1 | 150 | G.E. | 220/550 | 450 | I |
| 1 | 150 | Wagner | 440 | 1800 | —— |
| 1 | 150 | G.E. | 550 | 575 | I-K |
| 1 | 150 | West. | 2200 | 327 | I-8 |
| 1 | 150 | G.E. | 2200 | 600 | I-12 |
| 1 | 200 | G.E. | 440 | 900 | KT |
| 1 | 200 | West. | 220 or 440 | 720 | —— |
| 1 | 200 | G.E. | 220/550 | 600 | I |
| 1 | 200 | G.E. | 220/550 | 514 | I |
| 1 | 200 | West. | 2200 | 900 | CS-967A |
| 1 | 200 | West. | 220 | 580 | CS |
| 4 | 200 | Al. Ch. | 2300 | 347 | AN |
| 1 | 225 | G.E. | 2200 | 200 | Syn. |
| 1 | 250 | G.E. | 440 | 1200 | Open |
| 1 | 250 | G.E. | 2200 | 1175 | I-6 |
| Enew | 300 | West. | 440 | 1200 | —— |
| | | (Ball bearing—Acid Resisting) | | | |
| 4 | 400 | West. | 2200/220/440 | 500 | CS |
| 1 | 800 | G.E. | 6600 | 1200 | —— |
| 2 | 1000 | G.E. | 2300 | 509 | K |

## SLIPRING MOTORS—3 ph. 60 cy.

| No. | HP | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 1 | 1500 | West. | CW | 2200 | 435 |
| 1 | 400 | West. | CW | 440/220 | 1170 |
| 1 | 400 | West. | CW | 2200 | 435 |
| 1 | 350 | West. | CW | 2200 | 900 |
| 1 | 250 | West. | CW | 2200 | 345 |
| 1 | 100 | G.E. | I | 220 | 450 |
| 1 | 100 | West. | CI | 220/440 | 1750 |
| 1 | 75 | Cr. Wh. | | 220/440 | 875 |
| 2 | 60 | Triumph | C-16 | 220/440 | 430 |
| 1 | 60 | West. | HF | 2200 | 690 |
| 1 | 53 | G.E. | I | 220/550 | 1165 |

## TRANSFORMERS—1 ph. 60 cy.

| No. | Kva. | Pri. | Sec. | Make | Ph. |
|---|---|---|---|---|---|
| 1 | 250 | 2300 | 460 | G.E. | |
| 1 | 100 | 2200 | 110/220 | G.E. | |
| 3 | 100 | 6600 | 550/440/220 | Pgh. | |
| 3 | 50 | 11430/6600 | | Al. Ch. | |
| 3 | 50 | 6600 | 575 | G.E. | |
| 1 | 37½ | 2300 | 220/440 | Wagner | |
| 3 | 37 | 4400 | 185 | West. (Rotary) | |
| 35 | 10 | 2200 | 110/220 | G.E. | |
| 40 | 10 | 2200 | 110/220 | West. | |
| 100 | 7½ | 2200 | 110/220 | G.E. & West. | |
| 75 | 5 | 2200 | 110/220 | West & G.E. | |

## VARIABLE SPEED MOTORS—230 V. D.C.

| No. | Hp. | Make | Type | PRM |
|---|---|---|---|---|
| 1 | 250 | Cr. Wh. | CMC | 200/400 |
| 1 | 50 | West. | sk-163 | 390/980/1170 |
| 1 | 50 | West. | SK-163 | 390/980/1170 |
| 1 | 35 | West. | sk-140 | 675/1350 |
| 1 | 30 | West. | sk-123 | 850/1700 |
| 1 | 30 | G.E. | RLC | 450/900 |
| 4 | 20 | West. | sk-IOOL | 750/1500 |
| 2 | 10 | G.E. | lc | 625/1250 |
| 1 | 5 | G.E. | CD-85 | 450/1800 |
| 1 | 3.75/7.5 | West. | sk-111 | 300/1200 |
| 2 | 3 | Jantz Liest | BI | 650/1950 |

## 25 CY. MOTORS 220/440 V. A.C.

| Qu. | HP | Make | Type | RPM |
|---|---|---|---|---|
| 1 | 75 | G.E. | I-4 | 900 |
| 1 | 75 | Allis-Chalmers | AN | 900 |
| 6 | 40 | Allis-Chalmers | AN | 900 |
| 1 | 35 | Western Elec. | SL13B | 500 |
| 1 | 35 | West. | M | 900 |
| 1 | 30 | West. | C | 720 |
| 7 | 30 | Allis-Chalmers | AN | 900 |
| 2 | 25 | West. | MS | 715 |
| 9 | 10 | Allis-Chalmers | AN | 900 |

## COMPRESSOR

Chic. Pneu. 6¼x6, 160 cfm. displacement 2 cyl. vert., dir. con. to Gas or gasoline engine.

## DIESEL ENGINE GENERATOR SET

217 KVA. G.E. 2300/3/60 dir. con. 260 HP Buckeye 2 cyl. 200 rpm semi-diesel engine complete.

## KNIFE SWITCHES

18—300 Amp. S.P.S.T. 7500 v.
6—300 Amp. S.P.S.T.B.C. 15000 volts G E.

## INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractor 2000 lb. with batteries.
1—Baker Tow Truck with batteries.

## LATHE

1—Prentiss Engine Lathe, bench lathe, 7½" sw., length of bed 6', length 4½', screw cutting.

## PUMP

1—6x8 Deming Triplex Pump, 166 g.p.m., 150 lbs. pressure, 335' head, 20 H.P. A.C. or D.C. Motor.

## SCALES

9—Howe Scales, 3 beams (2 at 200# each—1 at 50#) Platform 14½" x 22", height 28", length 33½", width 16", approximate capacity 500#.

**Large Stock—CIRCUIT BREAKERS—METERS — CURRENT AND POTENTIAL TRANSFORMERS—POTHEADS—RELAYS—METERS — SAFETY SWITCHES — DISCONNECT SWITCHES — U-RE-LITES — PULLEYS — REACTORS.**

*WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS*

# DUQUESNE ELECTRIC & MFG. CO.

## PITTSBURGH 6, PA.

# ELECTRICAL EQUIPMENT IN STOCK
# REBUILT AND GUARANTEED

## 230-VDC. CRANE & MILL MOTORS
(SERIES AND COMPOUND)

| H.P. | Make | Type | R.P.M. |
|---|---|---|---|
| 1— 1 | P & H | 5½x3½ | 850 |
| 2— 2 | Shaw | Class B.E. | 930 |
| 1— 2½ | G.E. | C.O.-2502 | 750 |
| 1— 2½ (NEW) | Reliance | T-224 | 1600 |
| 4— 3 | Shaw | B.E. | 750 |
| 1— 3½ | G.E. | C.O.-2503 | 975 |
| 1— 7½10 | G.E. | MD-102 | 1025/800 |
| 1— 7½ | G.E. | C.O.-1806 | 700 |
| 1— 11/15 | Westgshe | K-5 | 700/630 |
| 1— 10 | C.W. | BW | 650 |
| 1— 15 | Westgshe | K-6 | 550 |
| 1— 20 | G.E.-115-V | C.O.-2504 | 850 |
| 2— 20/30 | G.E. | MD-104 (C.P.) | 725/575 |
| 3— 25 | G.E. | C.O.-1809 | 850 |
| 2— 30/45 | G.E. | MD-104½ (C.P.) | 625/500 |
| 1— 50 | G.E. | C.O.-1810 | 725 |
| 1— 50/66 | Westgshe | MCA-60 | 475/425 |
| 2— 65/85 | G.E. | C.O.-1830 | 700/650 |
| 1— 85 | G.E. | C.O.-1811 | 550 |

(All Motors are Series Wound except where marked C. P. Compound)

## ELECTRIC BRAKES AND CONTROL EQUIPMENT

2—5-HP. Cutler Hammer Brakes 230-VDC., series type "M" Size "0."
1—10-HP. P. & H. 230-VDC. SERIES. 9"x5½" Wheel.
2—NEW Westgshe. Type D.I. 104-F, 440-VAC. shunt.
2—Clark 230-VDC., shunt type 3-C, size 24, wheel 24"x7½".
20—Practically new G.E. drum controllers 230-VDC. type R-177-A with 35-HP. banks of resistance.
75—(Misc.) 230-VDC. 220/440-VAC. drum controllers, 5 to 75-HP.

## GENERAL PURPOSE 230-VDC. MOTORS

| H.P. | Make | Type | R.P.M. |
|---|---|---|---|
| 2— 2 | Allis. Chal. | E-50 | 1750-SH. |
| 1— 3 | G.E. | CD-55 | 1150-SH. |
| 1— 3 | Reliance | T-224 | 3500-SH. |
| 3— 5 | Westgshe | SK-40 | 850-SH. |
| 2— 5 | Westgshe | SK-30 | 1100-Comp. |
| 4— 5 | Westgshe | SK-30 | 1100-SH. |
| 2— 7½ | Westgshe | SK-60 | 850-Comp. |
| 1— 7½ | Westgshe | SK-40 | 1150-SH. |
| 1— 10 | Westgshe | SK-50-L | 1300-SH. |
| 1— 15 | Allis. Chal. | Shunt | 800 |
| 1— 15 | C.W. | Size 15-J | 800-Comp. |
| 1— 15 | G.E. | CD-75 | 1750-SH. |
| 2— 25 | Westgshe | SK-100-L | 1100-SH. |
| 1— 40 | Reliance | RH-992 | 1200-Comp. |
| 1— 75 | Westgshe | SK-160 | 850-Comp. |
| 1— 350 | C.W. | C.M. | 300-Comp. |

(Control Equipment with this Motor)

## VARIABLE SPEED

| H.P. | Make | Type | R.P.M. |
|---|---|---|---|
| 1— 2 | G.E. | R.F. | 500/2000-SH. |
| 1— 3 | G.E. | RLC-111 | 750/1500-SH. |
| 1— 3¾ | G.E. | RLC-112 | 600/1800-SH. |
| 1— 5 | Reliance | Frame E | 500/1800 |
| 1— 5 | Reliance | Frame F-943 | 450/1800 |
| 1— 5 | Westinghouse | SK-33 | 1150/1650-SH. |
| 1— 7½ | Reliance | G-903 | 275/1650-SH |
| 1— 7½ | Westinghouse | SK-103 | 400/1600-SH. |
| 1— 8 | Westinghouse | SK-100-L | 300/1200-SH. |
| 1— 70 | Reliance | 461-T | 600/1200-SH. |

(E. C. & M. AUTO. PANEL WITH 70-HP. MOTOR)
Auto. Control Available for Most of These Motors.

## MOTOR GENERATOR SETS

1—12-K.W. Westgshe factory built, Generator SK-70-L, 250-VDC., 1470-RPM., SQ. Cage motor C.S., 550-V., 3-PH., 26-CY., 1470-RPM., 2-bearings, complete panel (will furnish with 220/440-V., 3-PH., 60-CY. Motors).

2—125-K.W. Fairbanks Morse factory built, ball bearing throughout 1200-RPM., Generators, 275-VDC., compound wound motors, 200-HP. Synr. 2300/3/60-cy. with complete A.C. & D.C. panels.

## 220/440-V-3-PH-60-CY MOTORS
(CRANE TYPE)

| H.P. | Make | Type | R.P.M. |
|---|---|---|---|
| 1— 3 | Ideal | I.E.—Crane | 1600 |
| 1— 5 | G.E. | ITC-5201 | 675 (25-Cy.) |
| 1— 5 | G.E. | MTC-5200 | 820 |
| 1— 7½ | G.E. | MTC-5952 | 855 |
| 1— 11 | Louis Allis | Crane | 1200 |
| 1— 11 | P&H | HW-10A | 820 |
| 1— 15 | Electro Dy. | F.R.-601 | 1145 (2-Ph.) |
| 1— 22 | G.E. | ITC-5010 | 680 |
| 1— 22 | P&H | HW-20 | 840 |
| 1— 25 | Westinghouse | CI | 690 (2-Ph.) |
| 1— 30 | Westinghouse | CI | 690 |
| 1— 30 | Westinghouse | CI | 1150 |
| 2— 37 | G.E. | ITC-5011-A | 700 (25-Cy.) |
| 2— 35 | Westinghouse | CI 885 | 900 (2-Ph.) |
| 1— 40 | G.E. | ITC-5012 | 600 |
| 1— 52 | G.E. | ITC-5013 | 600 |

## (GENERAL PURPOSE)

SPECIAL: 14—Master Electric Motors, Explosion Proof, Fan Cooled, 2-HP., 1725-RPM. 220/440-V., 3-PH., 60 CY., Ball Bearing, with Mercury Clutch, Master Speed Ranger, Speeds 700-900-1060, 1260-1500-1780-2100-RPM.

| H.P. | Make | Type | R.P.M. |
|---|---|---|---|
| 1— 1½ | Louis Allis | B-224 | 1150 |
| 1— 1½ | G.E. | K.T. | |
| 2— 3¼ | G.E. | KT-201 | |
| | Above 1800/1200/900/600-R.P.M. with Rev. Cont.) | | |
| 8— 5 | G.E. | K-284 | 1150 |
| 1— 5 | F.M. | QZB | 1150 |
| 3— 5 | G.E. | KF-326 | 1740 |
| 1— 5 | G.E. | KT-VERT | 1800 |
| 1— 7½ | G.E. | KT-944 | 1800 |
| 1— 7½ | Sprague | MT-181 | 1800-(S.R.) |
| 2— 7½ | Louis Allis | OX-28 | 1740 |
| 1— 7½ | Westgshe | C.S. | 1200 |
| 1— 10/20 | G.E. | KT-522-Y | 600/1200 |
| 1— 10 | F.M. | O8-FW-324 | 1740 |
| 1— 12½/25 | Westgshe | | 880/1730 |
| | (Auto Control with this Motor) | | |
| 1— 20 | C.W. | | 1150 |
| 1— 20 | G.E. | 1 | 1200 |
| 1— 25 | Westgshe | CS | 900 |
| 1— 25 | F.M. | H-12-B | 900 |
| 2— 25 | F.M. | H-12-A | 1200 |
| 1— 25 | G.E. | KF-405 | 1170 |
| 2— 25 | G.E. | KT-326 | 1200 |
| 1— 25 (NEW) | Reliance | | 1150 |
| | (Fan Cooled with Auto Control) | | |
| 1— 35 | F.M. | H-12-B | 1200 |
| 1— 35 | G.E. | 1-Form-K | 1800 |
| 1— 50 | G.E. | KT-346 | 870 |
| 1— 75 | Westgshe | CW-752-C | 870 (S.R.) |
| | (With Automatic Control) | | |

## 220/440-Volts, 2-Phase, 60-Cycle

| | | | |
|---|---|---|---|
| 1— 2 | G.E. | K.Q.-730 | 1140 |
| 2— 7½ | Burke | E.B.-75 | 1200 |
| 2— 10 | Burke | E-M2 | 600 |
| 1— 10 | Allis Chal. | | 1700 |
| 1— 25 | Burke | | 1800 |

# T. B. MacCABE COMPANY
4306 CLARISSA ST. PHILADELPHIA 40, PA.

# Partial List Only!

## 230 VOLT DC MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 300 | G.E. | 1100 |
| 150 | West. | 600 |
| 60 | Roth | 600 |
| 60 | G.E. | 480/1100 (2) |
| 50 | West. | 550/1100 |
| 50 | Cr.Wh. | 700 (2) |
| 50 | G.E. | 850 |
| 45 | Diehl | 850/1020 |
| 40 | Cr. Wh. | 915 |
| 35 | West. | 1150 |
| 35 | G.E. | 440/1800 |
| 25 | Diehl | 850/1020 |
| 25 | G.E. | 1150 |
| 25 | G.E. | 575 |
| 20 | Cr. Wh. | 1750 |
| 20 | G.E. | 1200 |
| 20 | R & M | 1160 |
| 20 | G.E. | 1150 (4) |
| 20 | West. | 1150 |
| 20 | G.E. | 1150 |
| 20 | G.E. | 800 (2) |
| 15 | West. | 1250 |
| 15 | G.E. | 1250 |
| 15 | G.E. | 1150 (3) |
| 15 | G.E. | 1150 (3) |
| 15 | Cr. Wh. | 900/1800 |
| 15 | West. | 850 |
| 10 | West. | 850 (2) |
| 10 | G.E. | 825 (3) |
| 10 | G.E. | 700 |
| 10 | Al. Ch. | 600/1800 |
| 10 | West. | 600/1200 |
| 10 | G.E. | 400/1600 |
| 10 | West. | 400/1200 (2) |
| 9 | Al. Ch. | 1750 |
| 9 | G.E. | 450/1800 |
| 8½ | Diehl | 900 |
| 8½ | West. | 850 |
| 8½ | West. | 350/1400 |
| 8 | G.E. | 500/1500 |
| 7½ | Sturt. | 3600 |
| 7½ | Peerl's | 1700 |
| 7½ | West. | 1450 |
| 7½ | West. | 1150 (2) |
| 7½ | G.E. | 1150 |
| 7½ | West. | 975 |
| 7½ | Al Ch. | 850 |
| 7½ | El. Dy. | 550/1650 |
| 7½ | Watson | 525/1150 |
| 7½ | G.E. | 450/1800 |
| 7½ | G.E. | 400/1600 |
| 7½ | West. | 400/1600 |
| 7½ | Al. Ch. | 350/1050 |
| 7½ | G.E. | 300/1200 |
| 6 | G.E. | 400/1200 |
| 6 | G.E. | 850 |
| 6 | G.E. | 450/1800 (2) |
| 5½ | West. | 500/1500 (2) |
| 5 | West. | 850 |
| 5 | G.E. | 900 (2) |
| 5½ | G.E. | 400/1600 |
| 5 | West. | 1800 |
| 5 | G.E. | 1700 |
| 5 | G.E. | 1150 (2) |
| 5 | West. | 1160 |
| 5 | Al. Ch. | 1150 |
| 5 | Cont. | 600/1800 |
| 5 | West. | 850 |
| 5 | G.E. | 850 |
| 5 | Star | 600/1200 |
| 5 | El. Dy. | 550/1650 |
| 5 | G.E. | 450/1800 |
| 5 | G.E. | 600 |
| 5 | G.E. | 450/1350 |
| 5 | West. | 400/1200 |
| 5 | El. Dy. | 275/1100 |
| 4 | G.E. | 850/1150 |
| 3½ | West. | 850/1600 |
| 3 | West. | 1700 (5) |
| 3 | West. | 1150 (6) |
| 3 | Roth | 500/2000 |
| 3 | G.E. | 500/1500 |
| 2½ | West. | 480/1800 |

325-230 volt DC Mtrs. down to 1/20 H.P.

## 115 VOLT DC MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 20 | West. | 200/900 |
| 15 | West. | 1100 |
| 15 | Cr. Wh. | 800 |
| 10 | L. Allis | 3500 |
| 10 | G.E. | 1150 (3) |
| 10 | West. | 850 |
| 10 | El. Dy. | 425/1275 |
| 7½ | G.E. | 850 (2) |
| 6 | Burke | 650 |
| 5 | Cr. Wh. | 1875 |
| 5 | Col. | 1500 |
| 5 | West. | 1100 (2) |
| 5 | Cr. Wh. | 960 |

75 additional 110 volt Motors down to 1/6 H.P.

## 3 PHASE SQUIRREL CAGE MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 200 | G.E. | 600 |
| 150 | G.E. | 580 |
| 147 | West. | 715 |
| 100 | G.E. | 1200 |
| 100 | West. | 720 |
| 100 | G.E. (BTA) | 375/750 |
| 75 | West. | 870 |
| 50 | West. | 1200 |
| 50 | Al. Ch. | 690 |
| 40 | G.E. | 900 |
| 35 | Wagner | 850 |
| 30 | U. S. | 3450 Vert. |
| 30 | West. | 1750 Vert. |
| 30 | Al. Ch. | 850 |
| 30 | Al. Ch. | 514 |
| 25 | Wagner | 1200 |
| 25 | West. | 1140 |
| 25 | Diehl | 865 (3) |
| 25 | G.E. | 900 |
| 25 | Wagner | 720 |
| 20 | G.E. | 1750 (3) |
| 20 | G.E. | 1200 (2) |
| 20 | Cr. Wh. | 1200 (2) |
| 20 | Al. Ch. | 900 (2) |
| 20 | Diehl | 900 (3) |
| 20 | G.E. | 720 |
| 20 | West. | 1720 |
| 15 | Cr. Wh. | 1700 |
| 15 | G.E. | 1200 (3) |
| 15 | Wagner | 720 |
| 15 | G.E. | 600 |
| 10 | G.E. | 720 (5) |
| 10 | G.E. | 3450 |
| 10 | West. | 1150 |

40 additional three phase Motors down to ¼ H.P.

## TWO PHASE SQUIRREL CAGE MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 75 | Cr. Wh. | 870 |
| 50 | Linc. | 900 |
| 50 | G.E. | 900 |
| 40 | G.E. | 900 |
| 40 | Al. Ch. | 900 |
| 35 | Al. Ch. | 900 |
| 30 | West. | 1200 |
| 25 | G.E. | 1200 |
| 20 | West. | 1150 |
| 15 | G.E. | 1200 |
| 15 | F & M | 900 |
| 10 | G.E. | 1200 |
| 10 | G.E. | 900 |
| 7½ | G.E. | 900 |
| 7½ | G.E. (BQS) | 600/1350 |
| 5 | G.E. | 900 |
| 5 | Al. Ch. | 1200 |

40 additional two phase Motors down to ¼ H.P.

## SINGLE PHASE MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 20 | Wagner | 1160 |
| 20 | Cent. | 1165 |
| 7½ | Cent. | 3500 |

8 additional single phase Motors

## SLIP RING MOTORS

| H.P. | Make | Speed |
|---|---|---|
| 500 | Al. Ch. | 1180 |
| 250 | G.E. | 600 |
| 200 | West. | 720 |
| 200 | G.E. | 495 |
| 150 | Al. Ch. | 720 |
| 125 | West. | 1200 |
| 125 | Burke | 600 |
| 75 | Al. Ch. | 575 |
| 75 | West. | 1200 |
| 60 | West. | 1200 |
| 60 | West. | 290 |
| 50 | Ideal | 1740 |
| 50 | G.E. | 900 (3) |
| 40 | Wagner | 1200 |
| 40 | F & M | 900 (2) |
| 40 | West. | 900 |
| 40 | Lin. | 720 |
| 30 | G.E. | 720 |
| 30 | G.E. | 1200 |
| 25 | Al. Ch. | 900 |
| 25 | G.E. | 600 |
| 20 | G.E. | 900 |
| 20 | West. | 600 |
| 15 | G.E. | 900 |

33 additional slip ring Motors down to 1 H.P.

## 40 H.P.
## Reliance Variable Speed Motor Drive

**with**

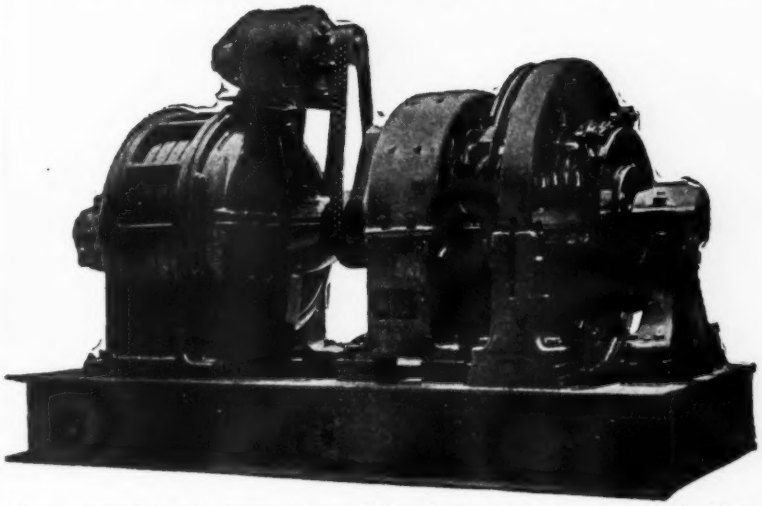
**60 H.P. 3 ph. 60 cy. 220-440 v. A.C. Motor Driving 40 K.W. A.C. adjustable speed control unit.**

**MOTOR: 40 H.P. 250 V. Speed**

**150 to 1500 R.P.M.**

***Push Button Remote Control Throughout***

# GENERATORS—
## Anodizing, Electroplating, etc.



Actual Photograph 1600 Ampere 10 to 60 Volt D.C. Generator, separate excited, driven by 3 phase, 60 cycle 220/440 Volt A.C. Motor.

**3—1600 Amp. Gen. Elec. 10 to 60 Volts.**

**2—1600 Amp. Westinghouse 7½ to 30 Volts.**

**3— 800 Amp. Westinghouse 7½ to 60 Volts.**
**Full Range Voltage Variation, Separate Excited.**

### AC GENERATORS

| | |
|---|---|
| 200 KW G.E. | 600 |
| 150 KW G.E. | 720 |
| 100 KW G.E. | 600 |
| 100 KVA West. | 600 |
| 75 KVA West. | 900 |
| 25 KVA West. | 1800 |

### BELTED AND MOTOR DRIVEN DC GENERATORS

| | |
|---|---|
| 200 KW West. | 600 volts |
| 80 KW El. Dy. | 250 volts |
| 60 KW G.E. | 600 volts |
| 50 KW West. | 125 volts |
| 45 KW West | 250 volts |
| 30 KW El. Dy. | 600 volts |
| 40 KW Cr. Wh. | 125 volts |
| 30 KW West. | 125 volts |
| 25 KW West. | 125 volts |
| 25 KW G.E. | 250 volts |
| 20 KW G.E. | 125 volts |
| 15 KW West. | 125 volts |

16 additional Motor Generator Sets, 125 volts-250 volts, 600 volts direct current down to 1 KW.

### MISCELLANEOUS

7x6 Ing.-Rand Air Compressor.
12½x12 American Air Compressor.

**1 Year Guarantee!**

**Completely Shop Reconditioned and Tested Before Shipment**

*New York City's Largest Stock Electrical Equipment*

# L. J. LAND & CO.

146 GRAND ST. *CAnal 6-6976* NEW YORK, N. Y.

READING, PA.
10TH AND EXETER STS.

YORK, PENNA.
227 NORTH GEORGE ST.

# GUARANTEED ELECTRICAL EQUIPMENT

## D.C. MOTORS
### 220 V. CONSTANT SPEED

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1— | ¾ | Roth | | 2350 |
| 1— | ¾ | Westgh. | CD823 | 1140 |
| 1— | 1 | Diehl | G401 | 1725 |
| 1— | 1 | Cr. Wh. | DL | 1750 |
| 2— | 1 | Gen. Elec. | RC22 | 1700 |
| 1— | 1 | Gen. Elec. | SD1266 | 1725 |
| 1— | 1 | Westgh. | SK23 | 450 |
| 1— | 1 | Star | 2SB | 850 |
| 1— | 1 | Emer. compd. | | 1750 |
| 3—1 | ½ | Cr. Wh. | GF | 850 |
| 1—1 | ½ | Emer. compd. | | 1750 |
| 1—1 | ½ | R & M | | 1750 |
| 1—1 | ½ | Westgh. | SK8A | 3450 |
| 2—1 | ½ | Westgh. | CD | 900 |
| 1—1 | ½ | Peerless | | 2050 |
| 1—1 | ½ | Diehl | G306 | 850 |
| 1— | 2 | Cr. Wh. | HO | 1150 |
| 1— | 2 | Cr. Wh. | HL | 1040 |
| 1— | 2 | Imper. | RVI | 1700 |
| 1— | 2 | Cr. Wh. | FL | 1625 |
| 1—2 | ½ | Gen. Elec. | RC8 | 450 |
| 1—2 | ½ | Watson | 5BW | 650 |
| 1— | 3 | Cr. Wh. | HL | 1150 |
| 1— | 3 | Cr. Wh. | HL | 1150 |
| 1— | 3 | Al. Chal. | | 1025 |
| 1— | 3 | Roth. ser. | | 1150 |
| 1— | 3 | Reliance | RDH | 850 |
| 2—3 | ½ | Cr. Wh. | IL | 690 |
| 1—3 | ½ | West. cpd. | 8K30 | 925 |
| 1— | 5 | Elec. Dyn. | 2S | 875 |
| 1— | 5 | Cr. Wh. | | 1075 |
| 1— | 5 | Gen. Elec. | RC7 | 1150 |
| 1— | 5 | Gen. Elec. | CVC112 | 1650 |
| 1— | 5 | Gen. Elec. | CD73 | 900 |
| 1— | 5 | Gen. Elec. | RC6 | 1700 |
| 1— | 5 | Gen. Elec. | RC7 | 1150 |
| 1— | 5 | Westgh. | SK40 | 850 |
| 1— | 5 | Westgh. | SK42 | 950 |
| 1— | 5 | Westgh. | SK | 1150 |
| 3— | 5 | Westgh. | SK30 | 1150 |
| 1— | 5 | Westgh. | CD | 1150 |
| 2— | 5 | Westgh. | SK20 | 1800 |
| 1— | 5 | Gen. Elec. | CQ | 1100 |
| 1— | 5 | Elec. Dyn. | 8½ | 3000 |
| 1— | 6 | Sprag. | LC | 1100 |
| 1— | 6 | Westgh. | S | 1465 |
| 1— | 6 | Gen. Elec. | RC10 | 475 |
| 1—7 | ½ | Al. Chal. | | 875 |
| 1—7 | ½ | Diehl | L10 | 1320 |
| 1—7 | ½ | Gen. Elec. | BD7 | 1600 |
| 2—7 | ½ | Gen. Elec. | RC9 | 850 |
| 1—7 | ½ | Gen. Elec. | RC9 | 850 |
| 1—7 | ½ | Gen. Elec. | RC27A | 1750 |
| 1—7 | ½ | Gen. Elec. | RC8 | 1150 |
| 1—7 | ½ | Gen. Elec. | CVC | 1525 |
| 1—7 | ½ | Westgh. | SK | 850 |
| 1— | 10 | Cr. Wh. | 7½-I | 1100 |
| 1— | 10 | Westgh. | SK70 | 850 |
| 2— | 10 | Sprague | LC | 1100 |
| 1— | 10 | Gen. Elec. | RC9 | 1150 |
| 2— | 10 | Westgh. | SK60L | 1150 |
| 1— | 10 | West. Elec. | CVC115 | 700 |
| 1— | 10 | Westgh. | SK40 | 1200 |
| 1— | 10 | Gen. Elec. | CD83 | 1150 |
| 3— | 15 | Cr. Wh. | 15-I | 800 |
| 1— | 15 | Westgh. | SK | 1100 |
| 1— | 15 | Gen. Elec. | RC10 | 1100 |
| 1— | 15 | Westgh. | SK90 | 825 |
| 1— | 15 | Westgh. | K10 | 1050 |
| 1— | 15 | Gen. Elec. | CVC11 | 925 |
| 1— | 15 | Reliance | 66-T | 1150 |
| 1— | 15 | Westgh. | SK80L | 1100 |
| 1— | 15 | Westgh. | SK100 | 675 |
| 1— | 15 | Westgh. | SK90 | 825 |
| 1— | 20 | Al. Chal. | | 1075 |
| 1— | 20 | Gen. Elec. | RC11B | 550 |
| 6— | 20 | Gen. Elec. | DLC201A | 900 |
| 1— | 20 | Sprague | LC-20 | 750 |
| 1— | 20 | Cr. W | 20-I | 775 |
| 4— | 20 | Gen. Elec. | RC12 | 800 |
| 1— | 20 | G. E. vert. | RC30 | 1150 |
| 1— | 20 | Gen. Elec. | CD95 | 850 |
| 1— | 20 | Cr. W. | 20-I | 775 |
| 1— | 20 | Elec. Dyn. | 7½S | 950 |
| 1— | 20 | Westgh. | S6 | 975 |
| 1— | 25 | Nor. West. | K12 | 1250 |
| 1— | 25 | Gen. Elec. | DLC | 750 |
| 1— | 25 | Gen. Elec. | RC32 | 800 |
| 1— | 30 | Gen. Elec. | MD8105 | 600 |
| 1— | 30 | Westgh. | SK120 | 975 |
| 1— | 40 | Gen. Elec. | CO2004 | 560 |
| 1— | 50 | Westgh. | SK130 | 1030 |
| 1— | 70 | Gen. Elec. | CO2007 | 460 |
| 1— | 75 | Gen. Elec. | GE211 | 340 |
| 1— | 75 | Westgh. | SK | 850 |
| 1—100 | | Cr. Wh. | CMC101H | 550 |
| 1—100 | | Westgh. | SK190 | 475 |
| 1—105 | | Gen. Elec. | CI-6 | 855 |
| 1—125 | | Gen. Elec. | CDP125 | 1750 |

## 250 VOLT ROTARY CONVERTERS

**1—3120-4030 KVA, 240-310 volt General Electric 3 ph., 25 cy., Booster type Rotary with transformer.**
**1—1500 KVA Westgh. compd. interpole 250 V. D.C., 600 RPM, with transformer, 3 ph., 60 cy., 2300 V., and panels.**
**2—1000 KVA Westgh. compd. interpole 250 V. D.C., 900 RPM, with transformer, 3 ph., 60 cy., 2300 V. and panels.**

**1—200 KW 275 V. Gen. Elec. Gen. to 300 HP, 3 ph., 60 cy., 2300 volt, type IK Induction motor.**

**1—937 KVA, 750 KW, 3 ph., 60 cy., 2300 V., 3600 RPM, Gen. Elec. Turbo Generator with C. H. Wheeler Condenser, pumps, etc.**
**1—625 KVA, 500 KW, 3 ph., 60 cy., 2300 V., 3600 RPM, Gen. Elec. non-condensing Turbo Generator.**
**The above are a few of the larger items in stock. Please send us your inquiries.**

**WE CARRY MANY OTHER ITEMS OF MOTORS, ETC. WHAT DO YOU NEED? WHAT HAVE YOU FOR SALE? SEND US YOUR INQUIRIES.**

## ADJUSTABLE SPD. MOTORS
### 220 VOLT DIRECT CURRENT

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1— | ½ | G.E. | RA4 | 600/1800 |
| 1— | ½ | Westgh. | SK204W | 1150/3000 |
| 1— | ½ | G.E. | BD224 | 600/1800 |
| 1— | ¾ | G.E. | BD35 | 600/1800 |
| 2— | ¾ | Westgh. | CD825 | 600/1800 |
| 16—1 | ½ | G.E. | RA5 | 820/1230 |
| 1—1 | ½ | G.E. | BD45 | 850/1350 |
| 3—1 | ½ | Westgh. | SK10 | 740/2200 |
| 3—1 | ½ | G.E. | BD45 | 850/1350 |
| 2— | 2 | Westgh. | SK33 | 500/2000 |
| 1—2 | ½ | Westgh. | SK20 | 740/2200 |
| 1— | 3 | Northern | | 720/1400 |
| 1— | 3 | Westgh. | SK43 | 500/2000 |
| 1—3 | ½ | El. Dyn. | S3 | 400/1600 |
| 1—3 | ½ | Westgh. | SK30 | 815/1630 |
| 1—3 | ½ | Westgh. | SK30 | 660/2000 |
| 1—3 | ½ | Westgh. | SK40 | 500/1500 |
| 1—3 | ½ | Westgh. | SK50 | 375/1500 |
| 1— | 4 | G.E. | RLC | 500/1500 |
| 1— | 5 | Triumph | F23 | 850/1700 |
| 3— | 5 | G.E. | RF9 | 450/1800 |
| 1— | 5 | G.E. | CD75 | 625/1875 |
| 1—6 | ½ | Westgh. | SK70 | 450/1800 |
| 1— | 7 | Westgh. | SA5 | 660/1320 |
| 2— | 8 | G.E. | RF10 | 400/1500 |
| 2—8 | ½ | Westgh. | SK90 | 350/1400 |
| 1— | 10 | Westgh. | SK90 | 400/1600 |
| 3— | 12 | G.E. | RF10 | 550/1650 |
| 9— | 15 | G.E. | RF10 | 550/1650 |
| 1— | 15 | W. El. | LC | 825/1250 |
| 1— | 15 | Westgh. | SK110L | 400/1600 |
| 1— | 20 | Jantz L. | 25EI | 400/1200 |
| 1— | 20 | G.E. | LC | 425/1275 |
| 1— | 20 | Westgh. | 8SA | 565/1130 |
| 2— | 20 | Westgh. | SK130 | 375/1500 |
| 4— | 20 | G.E. | RF12 | 400/1200 |
| 1— | 20 | Westgh. | SK110L | 500/1500 |
| 1— | 25 | G.E. | RF13 | 400/1200 |
| 1— | 25 | Westgh. | SK111L | 250/1000 |
| 2— | 35 | G.E. | RF14 | 250/1000 |
| 3— | 35 | G.E. | RF13 | 500/1500 |
| 3— | 35 | Reliance | 310T | 400/1200 |
| 2— | 35 | G.E. | LC | 650/1300 |
| 3— | 35 | Westgh. | SK160 | 400/600 |
| 1— | 35 | G.E.(50 HP mach. tool duty) | CD135 | 300/1200 |
| 1— | 37 | Sunderland Fge.&Eng | | 250/520/750 |
| 2— | 50 | G.E. | RF14 | 500/1500 |

## TRANSFORMERS—60 CYCLE
### 1 Phase Except As Noted

| Qu. | KVA | Make | Voltage |
|---|---|---|---|
| 1— | 3125 | Westgh. | 24000/12000x2400 |
| 1— | 200 | G.E. | 13200/220/440 |
| 2— | 200 | Westgh. | 440x220 |
| 1— | 150 | Westgh. | 13200x110/220/440 |
| 1— | 150 | G.E. | 2200/14200/4600Yx 230/575 |
| 2— | 100 | Westgh. | 2200x110/220 |
| 1— | 100 | Packard | 2200x440 |
| 2— | 75 | Westgh. | 2300x115/230 |
| 2— | 75 | G.E. | 2300x115/230 |
| 2— | 75 | Westgh. | 2200/120/240 |
| 1— | 75 | Pittsburgh | 2400x480 |
| 1— | 75 | Km'n | 264/242/220/198x110 |
| 1— | 55 | Westgh. | 2360x172/57 |
| 2— | 50 | Westgh. | 2400x240/120 |
| 1— | 50 | Westgh. | 2200x115/230 |
| 2— | 50 | Westgh. | 6900/13800x460/230 |
| 1— | 50 | G.E. | 2300x115/230 |
| 1— | 50 | Westgh. auto | 2200x1100 |
| 2— | 50 | Westgh. | 23000x460/230 |
| 1— | 50 | Westgh. | 13200x220/440 |
| 1— | 50 | Wagner | 220x220/110 |
| 1— | 50 | Adams Bag 3 ph. taps | 19000/11000/5500/220 |
| 1— | 50 | Adams Bag 3 ph. | 4000x230 |
| 2— | 40 | Westgh. | 2300x115/230 |
| 1— | 40 | G.E. | 2300x115/230 |
| 1— | 30 | Westgh. | 2400x120/240 |
| 3— | 25 | Westgh. | 2200x110/220 |
| 2— | 25 | Westgh. | 2200x110/220 |
| 1— | 25 | West. New | 4000x115/230 |
| 2— | 25 | Westgh. | 15000x220 |
| 2— | 25 | G.E. for 600 KW, 900 RPM, 3 wire 250-275 V. 25% unbalance | 4150x2300 |
| 2— | 25 | G.E. | 2300x115/230 |
| 1— | 25 | G.E. | 550x4400 |
| 2— | 25 | G.E. dry | 2300x115/230 |
| 1— | 25 | Duncan | 240x120/217 |
| 2— | 25 | Westgh. | 2200x110/220 |
| 5— | 20 | Westgh. | 2200x110/220 |
| 1— | 20 | Westgh. 3 ph. | 2200x220/440 |
| 1— | 20 | Westgh. | 2200x110/220 |
| 4— | 20 | Westgh. | 2200x110/220 |
| 2— | 20 | Westgh. | 2200x110/220 |
| 1— | 20 | G.E. | 2080x104/208 |
| 1— | 20 | G.E. | 2080x104/208 |
| 1— | 15 | G.E. | 2000x115/230 |
| 1— | 15 | G.E. auto | 220/110 |
| 1— | 15 | G.E. | 2300x115/230 |
| 5— | 15 | Westgh. auto | 240/120 |
| 6—12 | ½ | Westgh. auto dry (2 reg. for 25 KVA) 220 V. 2ϕ4 or 5 wire x 208 V. 3 ph. | |
| 1— | 10 | Westgh. 3 ph | 2200x110/220 |
| 6— | 10 | Gen. Elec. auto 220 V. 2ϕx208 V. 3ϕ | |
| 1— | 10 | Westgh. auto | 240x120 |
| 2— | 10 | G.E. st. lt. 2300 to 7.5 amp. | |
| 1— | 10 | Gen. Elec. 3 ph. 11500y/10350yx230/460 | |
| 1— | 7½ | Pittsburgh | 110/220x25 |
| 3— | 7½ | Wagner | 2300x230/460 |
| 1— | 7½ | G.E. | 2400x120/240/208 |
| 3— | 7½ | Westgh. | 1900/2200x110/220 |
| 4— | 7½ | G.E. | 2080x104/208 |
| 4— | 7½ | G.E. | 2080x104/208 |
| 1— | 7½ | G.E. auto | 220x110 |
| 1— | 7½ | G.E. | 1100/2200x110/220 |
| 10— | 5 | Westgh. auto dry | 230x208 |
| 6— | 5 | G.E. auto dry | 115/230x208 |
| 5— | 5 | Westgh. auto dry | 240x120 |
| 1— | 5 | Westgh. | 8800/4400x220 |
| 1— | 5 | G.E. | 2400x240/120/208 |
| 1— | 5 | G.E. | 2040x104/208 |
| 2— | 5 | Wagner | 2300x115/230 |
| 3— | 5 | G.E. | 2300x115/230 |
| 1— | 5 | Westgh. | 1900/2200x110/220 |

## 3 PH.—60 CY. MOTORS
### SQUIRREL CAGE

| Qu. | H.P. | Make | Volts | Type | Speed |
|---|---|---|---|---|---|
| 4— | 15 | G.E. | 440 | IK | 685 |
| 1— | 20 | Al. Ch. | 440 | AN | 1150 |
| 3— | 20 | Cr. W. | 440 | 118-Q | 900 |
| 2— | 20 | Cr. W. | 440 | 18-Q | 900 |
| 1— | 20 | G.E. | 220 | KT-342-Y | 870 |
| 1— | 20 | G.E. | 220 | KT-326 | 900 |
| 1— | 20 | Fair.-M. | 220 | H-12B | 900 |
| 1— | 20 | Westgh. | 220 | CS | 870 |
| 1— | 20 | Westgh. | 440 | CSW-444 | 700 |
| 1— | 20 | Westgh. | 220 | MS | 845 |
| 1— | 20 | Westgh. | 220 | CS | 1160 |
| 1— | 25 | Westgh. | 440 | CS-572 | 875 |
| 1— | 25 | Cr. W. | 440 | 118-Q | 1150 |
| 1— | 25 | Al. Ch. | 440 | AN | 875 |
| 1— | 25 | Fair.-M. | 440 | B | 1200 |
| 7— | 25 | G.E. | 440 | IK | 600 |
| 1— | 25 | G.E. | 440 | KT-342 | 870 |
| 1— | 25 | Watson | 220 | KH-13 | 845 |
| 1— | 25 | W.E. vt. | 550 | KT-522Y | 1200 |
| 1— | 25 | Westgh. | 220 | CS-744 | 685 |
| 2— | 30 | Al. Ch. | 440 | AN | 860 |
| 2— | 30 | Al. Ch. | 440 | AR-220D | 690 |
| 1— | 30 | Cr. W. | 440 | 120Q | 870 |
| 1— | 30 | G.E. | 440 | TS-7542 | 720 |
| 1— | 30 | Howell | 440 | SC-420 | 900 |
| 1— | 30 | Wagner | 440 | 19-TRM | 860 |
| 1— | 30 | R&M | 220 | K-202 | 1150 |
| 1— | 30 | Westgh. | 220 | CCL | 840 |
| 1— | 30 | Westgh. | 440 | CCL | 850 |
| 2— | 30 | Westgh. | 440 | CS-645 | 870 |
| 1— | 40 | Westgh. | 440 | CS | 1800 |
| 1— | 50 | G.E. | 440 | KT-552 | 420 |
| 1— | 50 | G.E. | 440 | KT-346 | 680 |
| 1— | 50 | G.E. | 220 | KT-546 | 680 |
| 1— | 75 | G.E. | | IK | 600 |
| 1— | 75 | G.E. | 220 | KT-558 | 600 |
| 1— | 75 | Lincoln | 220 | C-16 | 900 |
| 3— | 100 | G.E. | 440 | IK | 600 |
| 2— | 125 | Lincoln | 440 | C-16 | 1800 |
| 1— | 150 | West. | 440 | CS | 580 |
| 1— | 150 | G.E. | 440 | IK | 600 |
| 3— | 150 | West. | 440 | CS-856C | 870 |
| 2—West. reduction gears 870 to 38 rpm | | | | | |
| 1— | 290 | G.E. | 2300 | ATI | 720 |
| 1— | 300 | West. | 2300 | 8yn. | 900 |
| 1—2100 | | G.E. | 4600 | ATI | 514 |

## SLIP RING MOTORS
### 3 PH., 60 CY.

| Qu. | H.P. | Make | Volts | Type | Speed |
|---|---|---|---|---|---|
| 2— | 2 | G.E. | 440 | MT-936 | 900 |
| 1— | 3 | G.E. | 440 | BTA | 1650/550 |
| 2— | 3 | Ideal | 220 | A40-9 | 1100 |
| 2— | 5 | G.E. | 220 | MT-180 | 1700 |
| 1— | 5 | G.E. | 220 | MT-181 | 1200 |
| 1— | 5 | G.E. | 220 | MT-5938 | 1200 |
| 1— | 5 | G.E. | 440 | MTC-5189 | 1200 |
| 1— | 5 | West. 220/440 | | CI-254C | 1160 |
| 1— | 7½ | G.E. | 220 | MT-209 | 1800 |
| 1— | 7½ | G.E. | 550 | IM | 870 |
| 1—10 | | Burke | 220 | EMV-12 | 1200 |
| 2—10 | | Ideal | 220 | A61-13 | 1100 |
| 2—10 | | G.E. | 220 | IM | 690 |
| 3—10 | | G.E. | 220 | IM | 1200 |
| 1—10 | | Lloyd 220/440 | | JS-2613 | 1180 |
| 1—10 | | Wag'r | 220 | 19-TBR | 860 |
| 4—10 | | Wag'r | 220 | 17T-BR | 1140 |
| 1—11 | | West. | 220 | CI-460C | 870 |
| 4—11 | | G.E. | 440 | ITC-5008 | 815 |
| 1—15 | | Burke | 550 | EMV | 850 |
| 1—15 | | Ideal | 220 | A-80 | 1130 |
| 1—15 | | West. | 440 | CW-572 | 870 |
| 8—15/7½ | | West. | 440 | CW | 1200/600 |

(We have drum controllers, magnetic contractors to operate these motors from 300 to 1200 rpm)

| | | | | | |
|---|---|---|---|---|---|
| 1— | 20 | Burke | 550 | EMV-3 | 850 |
| 1— | 20 | G.E. | 440 | IM | 600 |
| 2— | 20 | G.E. | 440 | MT-[illegible] | 580 |
| 1— | 20 | West. | 440 | HF | 580 |
| 1— | 25 | Al. Ch. | 220 | | 885 |
| 1— | 25 | G.E. | 2200 | MT-326 | 1145 |
| 1— | 25 | West. | 220 | CW | 690 |
| 1— | 30 | G.E. | 220 | IM-10 | 690 |
| 1— | 30 | G.E. | 220 | MT-546 | 575 |
| 1— | 30 | G.E. | 2200 | MT-323 | 1800 |
| 1— | 30 | G.E. | 550 | MT-323 | 1800 |
| 3— | 30 | G.E. | 220 | MT-546Y | 575 |
| 1— | 30 | G.E. | 440 | MTC-5522Y | 900 |
| 1— | 30 | West. | 440 | CI-567C | 1160 |
| 1— | 30 | G.E. | 2200 | MT-332 | 1145 |
| 1— | 35 | G.E. | 220 | IM | 850 |
| 1— | 35 | West. | 440 | CW-646A | 690 |
| 1— | 35 | West. | 440 | CI-646A | 690 |
| 3— | 37 | G.E. | 440 | ITC-5011 | 1200 |
| 1— | 40 | G.E. | 550 | MT-336 | 850 |
| 1— | 40 | West. | 220 | CW-642C | 1160 |
| 2— | 50 | Al. C. | 2300 | ANY | 690 |
| 1— | 50 | G.E. | 220 | MTC-5326 | 1140 |
| 1— | 50 | G.E. | 440 | MT-542 | 865 |
| 1— | 50 | West. | 220 | CI-638A | 870 |
| 3— | 50 | G.E. | 440 | MT-356 | 600 |
| 3— | 50 | G.E. | 440 | MT-552 | 600 |
| 1— | 52 | G.E. | 220 | ITC-5013 | 570 |
| 1— | 60 | G.E. | 550 | MTC-5536 | 900 |
| 1— | 75 | West. | 440 | CW | 580 |
| 1— | 75 | Cr. W. | 440 | 24-Q | 700 |
| 1—100 | | West. | 550 | CW-868A | 720 |

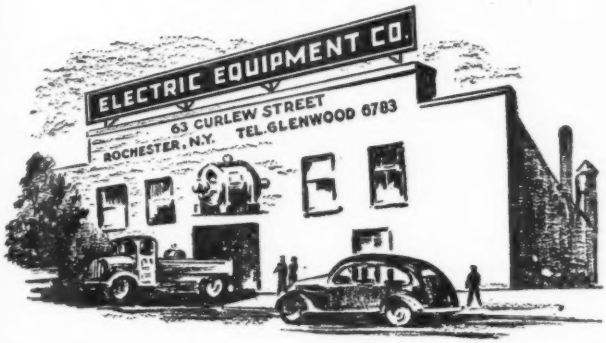
# KEYSTONE POWER PLANT EQUIPMENT CO.

**8403 HEGERMAN ST.** **PHILADELPHIA, PA., ZONE 36**

# "ELECTRIC EQUIPMENT" STOCK-LIST

# MOTORS

## THIS IS OUR NEW SHOP, WAREHOUSE AND OFFICE




## AC GENERATORS 60 CYCLE

| HP KVA | Make | Type | Volts | RPM |
|---|---|---|---|---|
| 300 KVA | G.E. | ATB-PB | 480 | 720 |
| 250 HP. | West. | 4846672 | 240 | 1800 |
| 240 HP. | G.E. | ATI | 2200 | 514 |
| 225 KVA. | G.E. | ATB | 2200 | 720 |
| 200 KW. | G.E. | ATB-PB. | 550 | 720 |
| 200 HP. | G.E. | ATI syn. | 2300 | 900 |
| 150 KW. | West. | 640451 | 2200 | 600 |
| 150 KW. | G.E. | ATI | 2300 | 900 |
| 150 KW. | G.E. | ATB-PB | 600 | 900 |
| 120 KW. | G.E. | ATB-PB | 2300 | 720 |
| 105 HP. | El.Ma. | BRT | 2300 | 1800 |
| 100 HP. | G.E. | ATI-PB | 2300 | 900 |
| 100 HP. | G.E. | ATI-PB | 220 | 900 |
| 75 KW. | G.E. | ARB-PB | 2300 | 900 |
| 75 KW. | G.E. | ATB-PB | 550 | 900 |
| 60 KVA. | G.E. | ATB-P | 2300 | 900 |
| 60 HP. | G.E. | ATI-PB | 4000 | 900 |
| 54 KVA. | G.E. | ATB | 220 | 900 |
| 50 KW. | G.E. | TRB | 240 | 1200 |
| 50 KVA. | West. | Ac gen. | 240 | 1200 |
| 37½ KVA | G.E. | ATB-PB | 240 | 1200 |
| 25 KW. | G.E. | TAB | 240 | 1800 |

40 Generators AC. in stock 20 KW. or smaller. Write for details.

## DIRECT CURRENT MOTORS

### CONSTANT SPEED—230 volt

| HP | Make | Type | RPM |
|---|---|---|---|
| 300 | G.E. | DMC INT | 800 |
| 200 | G.E. | MPC | 1200 |
| 100 | G.E. | CD 128 | 1200 |
| 75 KW. | Cr. Wh. | 81 H Gen. | 725 |
| 75 | Cr. Wh. | 516761 | 1050 |
| 60 | G.E. | RC 34 | 1050 |
| 60 | West. | SK 123L | 1800 |
| 50 | Cr. Wh. | CMC-H50 | 750 |
| 50 | Al-Ch. | E 123 | 1200 |
| 40 | G.E. | RC 15 | 700 |
| 40 | West. | SK | 775 |
| 40 | G.E. | RC | 1050 |
| 40 KW. | West.gen. | SK | 1800 |
| 35 KW. | G.E.gen. | DLC | 900 |

also 130 other DC motors—40 HP. and smaller any speed.

### VARIABLE SPEED—230 volt

| | | | |
|---|---|---|---|
| 175 | G.E. | DLC 208 | 650/ 925 |
| 80 | Burke | CD 60 | 200/ 625 |
| 60 | Sprg. | Intpl. | 480/1100 |
| 50 | G.E. | RLC | 400/1200 |
| 35 | West. | SK | 500/1500 |
| 35 | West. | SK | 300/1200 |
| 35 | West. | SK 150 | 400/1200 |
| 35 | G.E. | RF 14 | 400/1200 |
| 30 | El. Dy. | 208 | 400/1200 |
| 25 | E. Dy. | 208 | 410/1200 |
| 20 | West. | SK | 400/1200 |
| 20 | G.E. | RLC 203A | 300/ 900 |
| 15 | West. | 80 L | 1150/1800 |
| 15 | G.E. | RF 13 | 300/ 900 |
| 15 | West. | SK 92 | 600/1800 |

45 motors, 230 volts DC variable, all perd. 13 HP. or smaller.

## MOTOR GENERATOR SETS AC to DC

| Kw. | Make | Volts | Speed | Hp. | Cy. | Volts |
|---|---|---|---|---|---|---|
| 250 | G.E. | 250 | 1200 | 400 | 60 | 2300/440 |
| 200 | G.E. | 125 | 750/735 | 300 | 25 | 440 |
| 1—150 Kw. Westinghouse, SK, 125 volt, 900 rpm. | | | | | | |
| 285 HP. 4150/2300/550 volt synch. drive. | | | | | | |
| 100 | Cr. Wh. | 275 | 1750 | 150 | 60 | 2200 |
| 100 | West. | 250 | 600 | 145 | 60 | 440 syn. |
| 75 | G.E. | 250 | 1150 | 115 | 60 | 220 |
| 70 | Burke | 70 | 1200 | 110 | 60 | 220 syn. |
| 50 | West. | 125 | 750 | 75 | 25 | 2200 |
| 35 | G.E. | 125 | 1750 | 50 | 60 | 2300 |
| 25 | G.E. | 250 | 1200 | 35 | 60 | 220 |
| 10 | G.E. | 30 | 1500 | 20 | 25 | 220/440 |
| 9 | West. | 60 | 1750 | 15 | 60 | 220 |
| 8 | Al-Ch. | 125 | 1500 | 13 | 25 | 440 |
| 5 | West. | 80 | 1450 | 10 | 25 | 220 |

## MOTOR GENERATOR SETS AC to DC

| KW. | Make | Volts | Speed | Hp. | Cy. | Volts |
|---|---|---|---|---|---|---|
| 5 | West. | 80 | 1750 | 7½ | 60 | 220 |
| 5 | G.E. | 250 | 1750 | 10 | 60 | 550 |
| 3 | G.E. | 32 | 1800 | 7½ | 60 | 220 |
| 2½ | G.E. | 15 | 1800 | 5 | 60 | 220 |

## MOTOR GENERATOR SETS DC to AC

| Kva. | Make | Volts | Phase | Cy. | Hp. | Volts | Speed |
|---|---|---|---|---|---|---|---|
| 15 | West. | 250 | single | 60 | 25 | 230 | 1800 |
| 10 | G.E. | 220 | single | 25 | 15 | 230 | 750 |
| 7½ | West. | 220 | 3 | 60 | 13 | 230 | 1800 |
| 4 | West. | 220 | 3 | 60 | 5 | 230 | 1800 |

## 60 CYCLE MOTORS

### SQUIRREL CAGE

| HP | Make | Type | Volts | RPM |
|---|---|---|---|---|
| 400 | Al-Ch. | | 2300 | 500 |
| 200 | G.E. | I-K | 2200 | 600 |
| 150 | G.E. | I-K-16 | 2200 | 600 |
| 150 | Al-Ch. | AN | 2200 | 900 |
| 150 | Al-Ch. | AR | 440 | 900 |
| 150 | G.E. | I-K | 2200 | 1200 |
| 150 | West. | CS | 440 | 1800 |
| 150 | G.E. | I-K 13A | 2200 | 1800 |
| 125 | Tmph. | TR 14 | 440 | 1800 |
| 125 | G.E. | I-K | 4150 | 450 |
| 125 | West. | CS | 2200 | 3600 |
| 100 | G.E. | I-K | 2200 | 720 |
| 100 | G.E. | RT 556 | 2200 | 900 |
| 100 | G.E. | I-K | 440 | 900 |
| 100 | Al-Ch. | AR 226D | 440 | 900 |
| 100 | G.E. | KT 543 | 440 | 1200 |
| 100 | G.E. | I-K | 440 | 1800 |
| 75 | G.E. | KT 552 | 2200 | 900 |
| 75 | G.E. | KT 352 | 440 | 900 |
| 75 | Howell | SC | 440 | 1800 |
| 75 | West. | CS | 440 | 1800 |
| 75 | Ideal | A 306 B.B. | 440 | 3600 |
| 60 | G.E. | KT 333 | 440 | 1800 |
| 60 | G.E. | I-K 15A | 440 | 1300 |
| 60 | G.E. | I-K | 440 | 720 |
| 60 | G.E. | KT 542 | 550 | 900 |
| 60 | G.E. | KT 336 | 550 | 1200 |
| 60 | G.E. | KT | 440 | 1800 |
| 60 | F-Mse | HO121C | 440 | 3600 |
| 60 | G.E. | KT 527 | 2200 | 1800 |

300 Motors 30 HP. and smaller all speeds and types in stock.

### SLIP RING

| HP | Make | Type | Volts | RPM |
|---|---|---|---|---|
| 400 | G.E. | I-P | 2200 | 257 |
| 300 | G.E. | I-M | 2200 | 1200 |
| 200 | G.E. | I-M 17A | 440 | 514 |
| 200 | G.E. | I-M 17 | 550 | 514 |
| 200 | G.E. | I-M 17 | 2200 | 600 |
| 150 | G.E. | I-M 16 | 2200 | 600 |
| 150 | G.E. | I-M 16 | 550 | 600 |
| 150 | West. | CW | 2300 | 720 |
| 150 | Cr-Wh. | Late | 440 | 900 |
| 150 | G.E. | I-M | 2200 | 900 |
| 150 | G.E. | I-M 15 | 440 | 900 |
| 150 | West. | CW 771.1c | 440 | 1800 |
| 125 | G.E. | MT 547 | 2300 | 1800 |
| 112 | G.E. | ITC 5015 | 550 | 514 |
| 100 | G.E. | MT 356 | 440 | 900 |
| 100 | G.E. | I-M | 440 | 900 |
| 100 | G.E. | I-M | 440 | 1800 |
| 75 | Al. Ch. | ANY | 440 | 514 |
| 75 | G.E. | MT 556 | 550 | 720 |
| 75 | G.E. | MT 356 | 2200 | 720 |
| 75 | G.E. | I-M | 220 | 1800 |
| 60 | G.E. | MT 556 | 440 | 600 |
| 60 | G.E. | MT 352 | 440 | 720 |
| 60 | G.E. | MT 346 | 440 | 900 |
| 50 | G.E. | I-M | 440 | 514 |
| 50 | G.E. | MT 352 | 2200 | 720 |
| 50 | G.E. | MT 352 | 220 | 720 |
| 50 | G.E. | MT 346 | 2200 | 900 |
| 50 | G.E. | I-M | 440 | 1200 |
| 50 | G.E. | MT 346 | 440 | 1200 |
| 50 | West. | CW | 440 | 1800 |
| 50 | G.E. | I-M | 440 | 1800 |

50 Smaller slip ring motors 15 HP. and smaller any speed.

## 25 CYCLE MOTORS

### Alternators—Synchronous 3 phase, 25 cycle

| HP | KVA | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 600 | KVA | G.E. | ATI | 550 | 500 |
| 300 | HP | Elec. | Mach. | 440 | 214 |
| 100 | HP | Elec. | Mach. | 440 | 600 |
| 75 | HP | Elec. | Mach. | 2200 | 500 |
| 20 | KW | Ideal | | 240 | 1500 |

### SQUIRREL CAGE 220-440 volt 3 phase

| HP | Make | Type | Volts | RPM |
|---|---|---|---|---|
| 300 | G.E. | I-K | 440 | 1500 |
| 150 | G.E. | I-K | 440 | 750 |
| 150 | West. | CS | 440 | 1500 |
| 125 | G.E. | KT561 | 440 | 750 |
| 100 | West. | CCL | 440 | 500 |
| 100 | G.E. | I-K | 440 | 750 |
| 75 | G.E. | I-K | 440 | 750 |
| 75 | G.E. | I-K | 440 | 500 |
| 60 | Lincl. | 1N | 220 | 1500 |
| 50 | G.E. | I-K | 440 | 750 |
| 50 | G.E. | KT 353 | 440 | 750 |
| 50 | F-Morse | H-16B | 440 | 750 |
| 50 | West. | CS | 440 | 750 |
| 40 | West. | CS | 440 | 750 |
| 40 | G.E. | KT 343 | 440 | 750 |
| 40 | Al-Ch. | AN | 440 | 1500 |
| 40 | G.E. | KT 337 | 440 | 1500 |
| 35 | G.E. | I-K | 440 | 750 |
| 35 | West. | CS | 440 | 750 |
| 35 | G.E. | I-K | 440 | 1500 |
| 30 | Wagn. | 22 VBP | 220 | 750 |
| 30 | G.E. | KT | 440 | 750 |
| 30 | G.E. | KT 343 | 440 | 750 |
| 30 | West. | CS Tot.En. | 440 | 750 |

Also 150 motors from 20 HP. to 1 HP. all speeds.

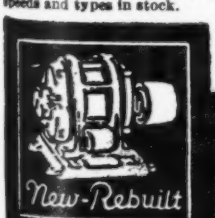
### SQUIRREL CAGE 2200 volt AC 25 cycle, 3 phase

| HP | Make | Type | Volts | RPM |
|---|---|---|---|---|
| 100 | G.E. | I-K | 2200 | 1500 |
| 100 | G.E. | KT 553 | 2200 | 1500 |
| 100 | West. | CCL | 2200 | 500 |
| 75 | West. | CS | 2200 | 750 |
| 50 | West. | CS | 2200 | 750 |
| 50 | Al-Ch. | AR 226M | 2200 | 1500 |
| 50 | G.E. | I-K | 2200 | 1500 |
| 40 | West. | CS | 2200 | 750 |
| 35 | G.E. | I-K | 2200 | 500 |
| 30 | G.E. | KT 337 | 2200 | 750 |
| 30 | West. | CS 752 | 2200 | 750 |

### SLIP RING 3 Phase, 25 cycle

| | | | | |
|---|---|---|---|---|
| 125 | Al-Ch. | AN | 440 | 750 |
| 125 | G.E. | I-M | 440 | 1500 |
| 100 | G.E. | I-M | 2200 | 375 |
| 100 | G.E. | MT 357 | 440 | 1500 |
| 75 | G.E. | I-M | 2200 | 750 |
| 75 | G.E. | I-M | 2200 | 500 |
| 75 | West. | CI 756A | 440 | 500 |
| 60 | West. | CW 765A | 440 | 750 |
| 50 | Al-Ch. | ANY | 220 | 300 |
| 50 | G.E. | I-M | 440 | 750 |
| 50 | West. | CW | 440 | 750 |
| 40 | West. | CW | 440 | 750 |
| 37 | G.E. | ITC 5015 | 220 | 750 |
| 30 | Al-Ch. | ARY | 440 | 1500 |
| 25 | G.E. | MT 337 | 220 | 750 |

25 other motors smaller than 25 HP. in stock.




## ELECTRIC EQUIPMENT CO.

63 CURLEW ST. PHONE: Glenwood 6783 ROCHESTER 1, N. Y.

**MOTORS • GENERATOR SETS • TRANSFORMERS • CAPACITORS • GAS ENGINES**
**AIR-OIL CIRCUIT BREAKERS • COMPENSATORS • ALTERNATORS • PANEL BOARDS**

# THE PICK OF POWER EQUIPMENT

### TURBO UNITS—60 CY.

1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 6000 KVA Westinghouse Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Allis Chalmers Cond.
1— 2500 KVA Westinghouse Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 1500 KVA Allis Chalmers Non-C.
2— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 625 KVA General Electric Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

### STEAM ENGINE UNITS—60 CY.

1—1067 KVA Nordberg Uniflow
1— 400 KW Ames Uniflow
1— 375 KVA Nordberg Uniflow
1— 340 KVA Skinner Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 250 KVA Ridgway 4-valve
1— 250 KVA Ames Uniflow
1— 210 KVA Skinner Uniflow

### D. C. STEAM ENGINE UNITS

1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Ridgway 4-valve 250 V. 3-wire
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire
1— 50 KW Ames Uniflow 125/250 V. 3-wire

### OIL & GAS ENGINE UNITS—60 CY.

1—500 KVA West. (gas) 440 V.
1—330 KVA DeLaVergne 2300 V.
1—312 KVA Anderson 2400 V.
1—200 KW Worthington 2300 V.
1—200 KVA Fairbanks Morse VA 2400 V.
1—187 KVA McInt.-Seymour 2300 V.
1—125 KVA Sterling Petrel (gas) 480 V.
1—121 KVA Fairbanks Morse 240 V.
1— 57.7 KVA Fairbanks Morse 240 V.
1— 37.7 KVA Caterpillar 120/208 V.

### SURFACE CONDENSERS

1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Ross
1— 2,310 sq. ft. Wheeler C. & E.

### WATER TUBE BOILERS

2—1452 HP B. & W. 350-lb., Stokers
1— 750 HP Edge Moor 200-lb.
1— 612 HP Stirling 250-lb., Pulverizer
1— 500 HP Stirling 250-lb., Stoker
1— 500 HP Stirling 200-lb., Stoker
1— 440 HP B. & W. 160-lb., Hand Fired
1— 400 HP Wickes 200-lb., Stoker
1— 335 HP B.&W. 200-lb., McClave-Brooks Stoker
4— 200 HP B. & W. 200-lb., Hand Fired

### A. C. GENERATORS

2—1500 KVA G. E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G. E. 60 cy. 480 V. 750 RPM
1— 750 KVA G. E. 60 cy. 230-460 V. 300 RPM
1— 680 KVA G. E. 25 cy. 13200-4000 V. 300 RPM
1— 500 KVA G. E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G. E. 60 cy. 2300 V. 600 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM

### SYNCHRONOUS MOTORS

2—1250 HP G. E. 25 cy. 2200 V. 750 RPM
2—1125 HP G. E. 60 cy. 480 V. 720 RPM
1— 850 HP G. E. 25 cy. 13200-4000 V. 300 RPM
1— 800 HP G. E. 60 cy. 440 V. 120 RPM
1— 770 HP G. E. 60 cy. 230-460 V. 300 RPM
1— 175 HP G. E. 60 cy. 230 V. 225 RPM
1— 175 HP G. E. 60 cy. 220 V. 200 RPM
1— 100 HP G. E. 60 cy. 2300 V. 240 RPM

### INDUCTION MOTORS—60 Cy.

4—3500 HP G. E. slip ring 2300 V. 120 RPM
1— 600 HP G. E. sq. cage 440 V. 900 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
2— 300 HP G. E. sq. cage 440 V. 600 RPM
2— 250 HP G. E. sq. cage 2300/4000 V. 1200 RPM

### MOTOR GEN. SETS—60 Cy.

1—1500 KW General Electric 600 V. DC
1—1500 KW Westinghouse 250 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 500 KW General Electric 250 V. DC
1— 75 KW General Electric 125 V. DC
2— 70 KW General Electric 125 V. DC

### ROTARIES—60 Cy.

1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

### FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G. E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G. E. 25/60 cy. 300 RPM
2—1250 KVA G. E. 25/62½ cy. 750 RPM
1—1000 KW G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 25/60 cy. 300 RPM
1— 600 KW G. E. 25/60 cy. 300 RPM

### SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
2—1250 KVA G. E. 480 V. 750 RPM
1— 750 KVA G. E. 230-460 V. 300 RPM
1— 500 KVA West. 2200 V. 900 RPM

### TRANSFORMERS—1 Ph. 60 Cy.

1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000/33000 V.
3— 200 KVA G. E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500-4600/2300 V.
3— 75 KVA G. E. 33000-13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3— 1500 KVA Pitts. 22000-6600 V.
2— 1000 KVA G. E. 23000/11500-575 V.
6— 833 KVA G. E. 22000-2300/4000 Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G. E. 22000-11000 V.
1— 5000 KVA American 13800-2300 V.
6— 1667 KVA Pitts. 13200-2300 V.
5— 1000 KVA G. E. 13200-2300 V.
3— 200 KVA G. E. 13200-2300 V.
7— 667 KVA Moloney 11000-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3—1250 KVA G. E. 6600-550 V.
3— 667 KVA G. E. 2300/4000Y-500/480/460 V.
5— 100 KVA G. E. 2300-230/460 V.

### VOLTAGE REGULATORS

**60 Cycle Induction**

1—72 KVA 300 A. 2400 V. Gen. Elec.
2—46 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

### OIL CIRCUIT BREAKERS

2— 600 A. 73 KV West. G222AS Outdoor
2— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G. E. FHKO36 Outdoor
6— 400 A. 37 KV G. E. FHKO136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
4— 600 A. 15 KV G. E. FKO60B Outdoor
2— 400 A. 15 KV G. E. FHKO136 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
2—1500 A. 15 KV G. E. FK12 Indoor
3— 600 A. 15 KV G. E. FK32C Indoor

*PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT*

## BREW, WOLTMAN & Co., INC.

50 CHURCH STREET, NEW YORK CITY

## SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM

## MOTOR GENERATORS

300 KW RW SYN. 250 V. 440/2300/4000 A.C. 720 RPM
200 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300 A.C. 1200 RPM
200 KW RW SYN. 250 V. 2300/4000 A.C. 900 RPM

*Each unit listed above is owned by us and is available now for immediate purchase.*

## WALLACE E. KIRK CO.

Incorporated

502 Grant Building Pittsburgh, Pa.

# BOILERS

**New and Used. Various makes, types, sizes and pressures**

**Turbines, Electrical Equipment, Air Compressors, Condensers, Conveyors, Coolers, Crushers, Elevators, Fans, Filters, Generators, Heaters, Pumps, Coal pulverizers, Turbo Generators**

## SURPLUS EQUIPMENT FOR THE WAR EFFORT.

Taken over from the E. I. Du Pont de Nemours & Co.
Carrollville, Wisconsin Plant.

## J. F. DAVIS CO. - - - CHICAGO

122 S Michigan ave - - - - - - - Phone—HARrison: 0755

## 1904—40 Years Continuous Service to Industry—1944

# READY TO GO—SPOT DELIVERY

## WRITE • PARTIAL LIST ONLY • WIRE

### DIRECT CURRENT MOTORS

**115 Volts**

| H.P. | Mfr. | Type | Speed |
|---|---|---|---|
| 40 | G.E. | RC 32 | 1150 |
| 20 | Whse. | SK-120 | 650 |
| 20 | L. Allis | WD-20 (Vert.) | 1000 |
| 15 | B. Brg. Cr. Wh. | CCM | 850 |
| 10 | Whse. | SK-60 | 1150 |
| 10 | Whse. | SK | 850 |
| 7½ | G.E. | RC | 1750 |
| ¼ (6) | | BD Vertical | 3450 |

Many other smaller motors, too numerous to list.

### DIRECT CURRENT MOTORS

**230 Volts**

| H.P. | Mfgr. | Type | Speed |
|---|---|---|---|
| 75 (2) | Reliance | 310T | 1450 |
| 65 | Cr. Wh. | CMC 65H | 600 |
| 61/70 (3) | G.E. | CDM | 352/400 |
| 50 | Cr. Wh. | CMC | 700 |
| 35 | G.E. | RF | 500/1500 |
| 30 | Reliance | 131T | 1450 |
| 30 | Imp. | | 850 |
| 30/35 | G.E. | CDM | 176/200 |
| 25 | G.E. | DLC | 750 |
| 25 | G.E. | CVC | 1200 |
| 20 | Reliance | 92T | 1450 |
| 20 | Whse. | SK-111 | 720 |
| 20 | Burke | WA-4 | 900 |
| 20 | G.E. | CD-105 | 600 |
| 20 | G.E. | CQ | 1700 |
| 20 | Whse. | SK-100L | 900 |
| 20 | Whse. | SK | 1700 |
| 20 | Al. Ch. | E-100 | 1150 |
| 20 (2) | G.E. | RC27B | 3450 |
| 20 | Triumph | 24F | 1750 |
| 20 | G.E. | RC-11 | 1150 |
| 20 | Elec. Dyn. | | 950 |
| 20 | Louis Allis | | 850/1700 |
| 15 | West. | SK-601 | 1700 |
| 15 | Roth | 7-S | 1150 |
| 15 (2) | G.E. | RC-30 | 850 |
| 15 (10) | Reliance | Ball bearing | 850 |
| 15 | Elec. Dyn. | | 600 |
| 15 | Whse. | SK-80 | 1100 |
| 15 | G.E. | RC-31 | 1100 |
| 15 | Cr. Wh. | CM | 1150 |
| 15 | G.E. | RC-30 | 850 |
| 15 | Imp. | HV-1 | 850 |
| 15 | Imperial | | 575 |
| 12½ | West. | SK | 400/1400 |
| 10 | Whse. | SK-63 | 1150 |
| 10 (2) | G.E. | LC | 1000/1500 |
| 10 | W. Elec. | ER3A | 1000 |
| 10 | G.E. | RC-29 | 850 |
| 10 | Cr. Wh. | CM | 850 |
| 10 | Whse. | SK-70 | 850 |
| 10 | Whse. | SK-90 | 600 |
| 10 | G.E. | RC-49 | 850 |
| 10 (2) | G.E. | CVC-115 | 700 |
| 7½ | G.E. | RC | 3450 |
| ½ (16) | G.E. | BD Vert. | 3450 |

The above listing is a very small part of the items in stock.

### DIRECT CURRENT GENERATORS

| KW | RPM | Volts | Make |
|---|---|---|---|
| 115 | 600 | 250 | Cr. Wh. |
| 100 | 1000 | 125 | G.E. |
| 100 | 900 | 125 | Whse. |
| 75 | 1750 | 250 | Reliance |
| 65 | 720 | 250 | Cr. Wh. |
| 30 | 1750 | 250 | Reliance |
| 25 | 490 | 125 | G.E. |
| 20 | 1750 | 250 | Reliance |
| 20 | 900 | 125 | Whse. |
| 15 (2) | 1140 | 250 | Reliance |
| 15 | 1140 | 125 | G.E. |
| 10 | 1140 | 250 | G.E. |
| 10 | 1750 | 125 | Whse. |
| 6 | 900 | 125 | Whse. |

Also a large assortment of special voltages. We specialize in building Motor Generator Sets to your specifications.

### MOTOR GENERATOR SETS

| KW | Make | D.C. Volts | Drive |
|---|---|---|---|
| 150 | Westgh. | 230 | 3/60/2300–550 |
| 50 | G.E. | 125 | 3/60/2300 |
| 25 | G.E. | 125 | 3/60/440 |
| 35 | Burke | 125 | 3/60/220 |
| 25 | Burke | 125 | 3/60/550 |
| 15 | G.E. | 125 | 3/60/440 |
| 6 (2) | G.E. | 75 | 3/60/220 |
| 3 | Roth | 125 | 3/60/220 |
| 3 | Chand. | 6–12 | 3/60/220 |
| 2 | Cont. | 120 | 3/60/220 |

### D.C. STEAM DRIVEN GENERATORS

**1—50 KW Crocker Wheeler 125 Volts, 2800 RPM direct coupled to a 80 HP Terry Turbine, 100 lb. pressure.**

**1—25 KW Engberg 230/125 Volts, 400 RPM, direct connected to a vertical Engberg Reciprocating Engine.**

### EXTRA SPECIAL

**NEW! NEW! NEW!**

**New, open and totally enclosed, fan cooled 3 phase 60 cycle motors, in various makes and speeds, from 3 HP to 60 HP.**

### DIRECT CURRENT CRANE AND MILL MOTORS

| Mfr. | Type | Speed | Volts |
|---|---|---|---|
| G.E. (2) | CO 1832 | 600 | 230 |
| G.E. (2) | CO 1811 | 600 | 230 |
| G.E. (2) | CO 1809 | 550 | 115 |
| G.E. | CO 1807 | 800 | 230 |
| G.E. | CO 1808 | 600 | 550 |
| G.E. | CO 1806 | 875 | 230 |
| G.E. | CO 1806 | 575 | 115 |
| G.E. (2) | CO 1803 | 600 | 230 |
| G.E. (2) | CO 1805 | 575 | 230 |
| Whse. | K-10 | 525 | 230 |
| West. (6) | K1 | 950 | 230 |
| West. (6) | K1 | 950 | 550 |
| West. | HK3 | 800 | 230 |
| West. | HK2 | 850 | 230 |
| Whse. (5) | HK-5 | 700 | 230 |
| West. | CK-9 | 335 | 230 |
| North. | K-T 35 H.P. | 800 | 230 |
| P & H | 12x8 | 430 | 230 |

The above items are constantly changing. Suggest you let us know your needs, if the item you want is not listed.

### SYNCHRONOUS MOTORS

**3 Phase 60 Cycle**

| H.P. | Mfr. | Volts | Type | Speed |
|---|---|---|---|---|
| 250 | Whse. | 440 | | 1200 |
| 250 | G.E. | 440 | ATI-PB | 720 |
| 187½ | Whse. | 220 | | 600 |
| 175 | G.E. | 220 | ATI-PB | 514 |
| 175 | West. | 440 | | 900 |
| 125 | Cr. Wh. | 220 | | 900 |
| 100 | Whse. | 440/220 | | 900 |

### AC GENERATORS

| KVA | Mfr. | Volts | Type | Speed |
|---|---|---|---|---|
| 300 | G.E. | 600 | ATB-PB | 600 |
| 225 | G.E. | 480 | ATB-PB | 720 |
| 225 | Whse. | 440/22 | Pedestal | 1200 |
| 225 | West. | 2300 | | 600 |
| 200 | Lincoln | 220 | | 720 |
| 187½ | Whse. | 240 | Pedestal | 600 |
| 150 | G.E. | 240 | ATB | 514 |
| 150 | Al. Ch. | 440 | | 900 |
| 100 | Cr. Wh. | 240 | | 900 |
| 100 | West. | 240 | | 900 |
| 7½ | G.E. | 220 | AS | 1800 |

### SLIP RING MOTORS

**3 Phase 60 Cycle**

| H.P. | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 600 | Whse. | CW | 2200/ 550/440 | 590 |
| 400 | G.E. | IM | 2200/ 550/440 | 720 |
| 250 | G.E. | IM | 440 | 514 |
| 200 | Cr. Wh. | | 2200 | 600 |
| 200 | Whse. | CW | 200 | 1150 |
| 150 | G.E. | IM | 2200 | 600 |
| 150 | G.E. | IM | 550 | 600 |
| 100 | Wshe. | CW | 440 | 600 |
| 75 (3) | G.E. | MT | 440/220 | 1200 |
| 75 (2) | Cr. Wh. | SR | 440/220 | 1200 |
| 75 | Whse. | CW-746 | 440/220 | 1200 |
| 52 | G.E. | ITC5012 | 440 | 900 |
| 50 | G.E. | IM | 440 | 900 |
| 50 | Cr. Wh. | | 440 | 900 |
| 50 (2) | G.E. | MT | 440/220 | 900 |
| 50 | G.E. | I-M | 440 | 1200 |
| 50 | G.E. | MT-556Y | 220 | 600 |
| 40 | Al. Ch. | | 440 | 900 |
| 40 | G.E. | MT | 220 | 1200 |
| 40 | Whse. | CW | 2200 | 1750 |
| 40 | Whse. | CW-636A | 220 | 1160 |
| 40 | G.E. | MT | 550 | 900 |
| 40 (2) | Whse. | CW | 550 | 900 |
| 37 | G.E. | ITC5012 | 220 | 600 |
| 35 | Ridgway | | 2200 | 600 |
| 35 | G.E. | IM | 2200 | 1200 |
| 35 | G.E. | IM | 2200 | 900 |
| 35 (2) | G.E. | IM | 220 | 720 |
| 30 | Fks. M. | | 220 | 1200 |
| 30 | G.E. | MT 332 | 220 | 900 |
| 30 (2) | G.E. | MT-336 | 220 | 900 |
| 30 | G.E. | MT-342 | 220 | 720 |
| 27 | G.E. | IM | 440 | 600 |
| 25 | Al. Ch. | | 550 | 1800 |
| 25 | G.E. | MT 536 | 550 | 720 |
| 25 | Diehl | KK14R | 220 | 850 |
| 20 | Fks. M. | | 220 | 1200 |
| 15 (2) | G.E. | IM | 220 | 1200 |
| 15 | Al. Ch. | ARY | 550 | 1200 |
| 15 (2) | G.E. | IM | 220 | 900 |
| 15 | G.E. | MT 312 | 220 | 900 |

A large assortment of smaller sizes as low as 1½ H.P.

### SQUIRREL CAGE

**3 Phase 25 Cycle**

| H.P. | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 125 | Whse. | CS | 440 | 720 |
| 100 (2) | G.E. | IK | 440 | 500 |
| 75 | Whse. | CCL | 550 | 480 |
| 40 (3) | Al. Ch. | | 550 | 3400 |
| 30 | Whse. | CS | 440/220 | 720 |
| 35 | West. | MS | 440 | 720 |
| 25 | G.E. | IK | 440 | 720 |
| 25 | Ideal | A | 440 | 720 |
| 25 | West. | CS | 440 | 720 |
| 20 | G.E. | IK | 220 | 720 |
| 20 | West. | CCL | 220 | 1500 |
| 20 | Wagner | | 440 | 1500 |
| 20 | West. | CS | 440 | 600 |
| 20 | G.E. | IK | 440 | 1500 |
| 17½ | Lincoln | | 220 | 1500 |
| 15 | Whse. | CCL | 440 | 500 |
| 15 | Wagner | 17TBP | 440/220 | 1500 |
| 15 | Ideal | A | 440 | 1500 |
| *15 | Cent. | RS 30S | 220/110 | 1500 |
| 15 | Ideal | AVE | 440 | 720 |
| 15 (2) | Burke | | 440 | 1500 |
| 10 | G.E. | IK | 220 | 500 |
| 10 | G.E. | KT 958 | 440/220 | 1500 |
| 10 | Whse. | CCL | 220 | 1500 |
| 10 | Whse. | CS | 440/220 | 750 |
| 10 | Ideal | A-80 | 440 | 750 |
| 10 (2) | Whse. | CS-567 | 440/220 | 750 |
| 10 | Whse. | CS | 440/220 | 500 |
| 5 (2) | G.E. | KT | 440 | 1500 |
| 5 (3) | West. | CS | 440 | 1500 |

*Single Phase.

A large assortment of smaller sizes.

### SPECIAL

**Two 15x36 Cutler - Hammer Rectangular Magnets.**

**SPECIAL! SPECIAL!**

### A.C. GENERATORS

**31½ KVA, 25 KW, 120/208 V., 1200 RPM. Ball bearing with direct connected exciters and rheostats. Adaptable for direct connection to diesel, gasoline or electric motor drive.**

### SLIP RING

**3 Phase 25 Cycle**

| H.P. | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 150 (2) | G.E. | IM | 440 | 500 |
| 150 | Triumph | 3-bearing | 2200 | 720 |
| 100 | G.E. | IM | 440 | 750 |
| 25 | G.E. | MTC 5323 | 440 | 750 |
| 15 | G.E. | MTC-Hoist Duty | 440 | 675 |
| 15 | Whse. | HF | 440 | 710 |
| 10 | G.E. | MT 323 | 220 | 750 |
| 10 | G.E. | MT 523 | 220 | 750 |

[ A partial listing.

### SQUIRREL CAGE MOTORS

**60 Cycle 3 Phase**

| H.P. | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | G.E. | | 2200 | 600 |
| 225 (3) | Whse. | IK | 2200 | 720 |
| 225 | G.E. | CS | 440 | 900 |
| 200 | C.W. | IK | 440 | 900 |
| 200 | G.E. | IK | 440 | 900 |
| 200 | Burke | EM50 | 440 | 600 |
| 200 | G.E. | IK | 440 | 600 |
| 200 | G.E. | IK | 2200 | 514 |
| 200 | Cr. Wh. | | 440 | 720 |
| 150 (2) | G.E. | IK | 440 | 720 |
| 150 | Al. Ch. | | 2200 | 1800 |
| 150 | Al. Ch. | | 440 | 1800 |
| 150 | Cr. Wh. | | 2200 | 600 |
| 150 | Burke | EM 209 | 440 | 720 |
| 150 | Al. Ch. | | 440 | 600 |
| 125 | G.E. | IK | 440 | 720 |
| 125 | Cr. Wh. | | 2200 | 600 |
| 100 | G.E. | IK | 550 | 720 |
| 100 | G.E. | IK | 550 | 600 |
| 100 (4) | G.E. | I-L | 550 | 720 |
| 100 | G.E. | IK | 550 | 900 |
| 100 | G.E. | KT | 550 | 900 |
| 100 | G.E. | KT346 | 440 | 1200 |
| 100 | West. | CS | 440 | 720 |
| 75 | G.E. | I-L | 440 | 360 |
| 75 | G.E. | I-L | 440 | 514 |
| 75 | Al. Ch. | | 220 | 720 |
| 75 | G.E. | I-K | 440 | 720 |
| 75 | G.E. | I-L | 550 | 720 |
| 75 (2) | West. | CS | 440 | 900 |
| 75 | G.E. | Vert. | 440 | 1200 |
| 60 | Al. Ch. | Sp. pr. | 2300 | 1800 |
| 60 (2) | G.E. | IK | 440/220 | 1200 |
| 60 | F.M. | H | 440 | 900 |
| 50 | Al. Ch. | | 2300 | 900 |
| 50 | Ridgway | | 2300 | 600 |
| 50 | G.E. | KT342 | 2300 | 900 |
| 50 | West. | CS | 440 | 900 |
| 50 (2) | West. | CS | 220 | 720 |
| 50 | G.E. | KT552 | 440 | 720 |
| 40 | G.E. | K | 550 | 900 |
| 40 (2) | Al. Ch. | | 440 | 900 |
| 40 | G.E. | I-L | 440/220 | 900 |
| 40 | Cr. Wh. | | 220 | 1200 |
| 40 | F.M. | H | 220/440 | 900 |
| 40 | G.E. | KT342 | 440/220 | 900 |
| 40 | Al. Ch. | | 440 | 1200 |
| 40 (3) | Al. Ch. | B. B. | 550 | 3450 |

A large assortment of smaller sizes too numerous to list.

**ALL EQUIPMENT GUARANTEED FOR ONE YEAR**

**★ WANTED TO BUY: Stationary Air Compressors, Belt or Steam Driven**

*Benjamin's for Motors, Inc.*

ESTABLISHED 1904

WIndsor 5-1700

12th AVENUE AND 37th STREET ★ BROOKLYN, 18, N. Y.

# MOTORS • GENERATORS • TRANSFORMERS

## Prices on Application

**3 PHASE, 60 Cycle, 220/440 V.**

| HP | Make | RPM | Type | Frame |
|---|---|---|---|---|
| 7½ | Gen. Elect. | 1200 | KT | 952 |
| 10 | Gen. Elect. | 720 | K | 404 |
| 10 | Gen. Elect. | 900 | KT | 312 |
| 15 | West. | 1800 | CS | |
| 20 | Gen. Elect. | 900 | KG | 405 |
| 20 | Armor | 900 | ball bearing | |
| 20 | Fairbanks Morse | 900 | ball bearing | |
| 20 | Fairbanks Morse | 1200 600 | two speed | |
| 25 | Westinghouse | 900 | CS | 444 |
| 30 | Armor 2-phase | 720 | ball bearing | |
| 40 | Westinghouse | 1800 | CS | |
| 50 | Gen. Elect. | 1800 | IK | |
| 50 | Westinghouse | 900 | CS | 505 |
| 50 | Westinghouse | 900 | CS | 646A |
| 50 | West. | 1800 | CS | |
| 60 | Gen. Elect. | 1800 | I | form K |
| 75 | Gen. Elect. | 1800 | I | form K |
| 75 | Gen. Elect. | 900 | KT | 552 |
| 100 | Gen. Elect. | 1800 | I | form K |
| 100 | West. | 1800 | CS | |
| 150 | Gen. Elect. | 1200 | I | form K |
| 150 | Gen. Elect. | 1200 | I | form K |

### TRANSFORMERS

| Amt. | Kva. | Make | Cycle | Voltages |
|---|---|---|---|---|
| 3 | 25 | Gen. Elect. | 25 | 2300/115/230 |
| 3 | 50 | Gen. Elect. | 25 | 2300/115/230 |
| 3 | 75 | Gen. Elect. | 60 | 4600/230/460 |
| 3 | 100 | Gen. Elect. | 25 | 2300/115/230/460 |
| 2 | 150 | Westinghouse | 25 | 2300/115/230/460 |
| 3 | 200 | Gen. Elect. | 60 | 2300/230/460 |
| 3 | 250 | Gen. Elect. | 60 | 13,000/2300 |
| 3 | 250 | Westinghouse | 60 | 11500/460 |
| 2 | 333 | Westinghouse | 60 | 2300/230/460 |
| 3 | 500 | Pittsburgh | 25 | 11,000/220 |
| 4 | 833 | Allis Chalmers | 60 | 13,200/440 |
| 3 | 1000 | Pittsburgh | 60 | 2300/4600/230/460 |

**SPECIAL**

**3—250 KVA. Westinghouse Transformers Type SL 11,500 volts Primary 460 volts. Secondary, 60 cycle 1 phase. Used less than 1 year.**

### Mine Slope Hoist

**1—Connellsville Mfg. and Mine Supply Hoist storage capacity for 11,000 feet 1" Rope—Speed 900' per minute.**
**Motor—500 HP Gen. Elec. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.**
**Write Wire Phone**
**Inspection can be made for 30 days in operation. This machine almost new.**

### MOTOR GENERATOR SETS

1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.
?—150 KW Westinghouse Synchronous-Generator 250-275 V. DC. Motor 3/60/2300/900 RPM complete with panels.

**3 PHASE, 25 CYCLE, 220/440 VOLTS**

| HP | Make | RPM | Type | Frame |
|---|---|---|---|---|
| 5 | Al. Chal. | 720 | AR | |
| 5 | Wagner | 1450 | Ball B. | Enclosed |
| 7½ | West. | 750 | CS | |
| 7½ | G.E. | 1500 | KT | 181 |
| 10 | G.E. | 750 | KT | 312 |
| 10 | West. | 750 | CS | |
| 10 | West. | 1500 | CS | |
| 10 | G.E. | 1500 | I | Form K |
| 15 | G.E. | 750 | KT | |
| 15 | West. | 1500 | CS | |
| 20 | West. | 750 | CS | |
| 25 | West. | 750 | CS | |
| 50 | G.E. | 750 | I | Form K |
| 50 | West. | 750 | CS | |
| 75 | G.E. | 750 | KT | 357 |
| 75 | G.E. | 750 | I | Form K |
| 100 | G.E. | 300 | I 17 | Form K |
| 150 | G.E. | 750 | I | Form K |
| 150 | G.E. | 750 | I | Form K |
| 200 | West. | 460 | CS | 2200 Volt |
| 200 | G.E. | 750 | I | Form K |
| 225 | Elec. Ma. | 500 | 2200 V. | Synchron |
| 1150 | G.E. | 375 | 2300 V. | Synchron |
| 200 | West. | 235 | CW | Slipring |

## Prices on Application

### SLIPRING MOTORS

**60 CYCLE, 3 PHASE, 220/440 VOLTS**

| HP | Make | Speed | Type | Frame |
|---|---|---|---|---|
| 10 | Gen. Elect. | 1800 | MT | 303 |
| 15 | Gen. Elect. | 1800 | I | form M |
| 20 | Gen. Elect. | 545 | MT | 332 |
| 20 | Westinghouse | 575 | CW | 648A |
| 20 | Westinghouse | 575 | CW | ball bearing |
| 25 | Westinghouse | 690 | CW | |
| 30 | Gen. Elect. | 1800 | MT | 327 |
| 30 | Gen. Elect. | 1800 | I | form M |
| 40 | Westinghouse | 690 | CW | 748 |
| 40 | Westinghouse | 690 | CW | 748A |
| 40 | Westinghouse | 690 | CW | 748A |
| 40 | Westinghouse | 690 | CW | 748A |
| 50 | Westinghouse | 900 | CW | |
| 60 | Westinghouse | 720 | CW | 2200 volt |
| 75 | Westinghouse | 1800 | CW | |
| 500 | Westinghouse | 600 | CW | |

**SPECIAL**

**2—500 HP. Gen. Elec. Motors, Type I, Form K, 3/60/440/900 RPM, with Starting Compensatiors.**
**1—500 HP. Gen. Elec. Motor, Type KTP, 3/60/440/1200 RPM with Starting Compensator.**

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM. direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 200 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

**150 HP D.C. MOTOR**
**150 HP. Westinghouse Type SK, 180L, 230 V., 1100 RPM, Compound Interpole. Serial No. 2221504.**

# ERIE ELECTRIC CO., INC.

**124 CHURCH ST. BUFFALO, N. Y. CL. 4758**

# POWER PLANT EQUIPMENT CO., Inc.

**39 Cortlandt Street New York, N. Y.**

### A C TURBINE UNITS

6250 KVA G.E. 2300 V., cond.
4000 KVA Al. Chal. 2300 V. cond.
3125 KVA G.E. 4100/2300 V. cond.
2500 KVA G. E. 2300 V. cond.
2500 KVA Al. Chal. 440 V., cond.
1875 KVA Al. Chal. 2300 V. cond.
1250 KVA (2) G. E. 2300 V. cond.
940 KVA Wghse. 6600 V. cond.
937 KVA G. E. Auto BLEEDER, 2300 V.
937 KVA G. E. 2300 V., cond.
937 KVA Al. Chal. 2300 V., 300#.
780 KVA Al. Chal. 2300 V., cond.
625 KVA Wghse. 2300 V., cond.
375 KVA G. E. 2300 V., cond.
312 KVA Elliott 480 V., cond.
250 KVA Al. Chal. 480 V. Auto BLEEDER.
150 KVA Wghse, 240 V. cond.
(Non-Cond.)
375 KVA G.E. 2300 V.
312 KVA C.W.—Moore, 450#, 240 V.
175 KVA Al. Chal.—Sturtevant 220 V.
75 KVA Al. Chal., 240 V.

### STEAM ENGINE SETS (A C)

500 KVA (2) G. E.—24 x 48 Bates Corliss.
490 KVA Wghse.—Hamilton Cross Comp.
420 KVA Wghse.—Erie Ball Cross comp.
375 KVA G. E.—22 x 27 Erie Ball, 4 V.
210 KVA G. E.—19 x 20 Skinner Unif.
150 KVA G. E.—16 x 15 Skinner Unif.
150 KVA G. E.—16 x 36 Skinner S. V.
125 KVA G. E.—12 x 21 Hamilton 4 V.
100 KVA G. E.—14 x 15 Skinner Unif.

### DIESEL ENGINE SETS

500 KVA Wghse.—Busch Sulzer
375 KVA Wghse.—Busch Sulzer
312 KVA G. E.—Anderson
312 KVA G. E.—McIntosh Sey.
200 KVA G. E.—Busch Sulzer
170 KVA F. M.—F. M. "VA"
140 KVA E. M.—Fairbanks Morse "V"
121 KVA F. M.—F. M., 32-E
100 KVA C. W.—Bessemer
90 KVA (4) F. M.—F. M. "VA"
75 KVA C. W.—Caterpillar
75 KVA Al. Chal.—International
58 KVA F. M.—F. M. 32-E
50 KVA F. M.—F. M. 6 cyl.
38 KVA C. W.—Caterpillar
32 KVA F. M.—F. M., 6 cyl.

**SPECIAL**

**937 KVA G. E. 3-60-2300 V., Auto BLEEDER. With complete equipment.**
**937 KVA G. E. 3-60-2300 V., Condensing. With complete equipment.**

### W T BOILERS

749 HP (2) Edgemoor, 200#
728 HP Erie City, Ver. 200#
600 HP Connelly, 200#
600 HP Heine, 200#
522 HP Sterling, 207#
471 HP Erie City Ver., 160#
396 HP B.&W., 160#
264 HP B.&W. (heating)
250 HP Sterling, 160#
200 HP (2) Scotch Marine, 15#

### PUMPS (MOTOR DRIVEN)

7500 GPM, 80' head
4000 GPM 70' head
3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
3000 GPM (2) 65' head
1390 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
650 GPM 810' head
350 GPM 720' head

### STEAM ENGINE SETS (D C)

450 KW C. W. 250 V.—Nordberg Unif.
300 KW G. E.—Skinner Unif.
150 KW G. E.—Erie Ball 4 V.
100 KW G. E.—Erie Ball 4 V.

### AIR COMPRESSORS

2200 CFM Nordberg 100#, steam and motor driven
1080 CFM Nordberg 85#,—motor
Steam driven—all sizes
Gas driven—80-100 HP, 200/300#

### TRANSFORMERS

687 KVA (2) Maloney 13800-460 V.
500 KVA (3) Al. Chal. 33000-440 V.
500 KVA (2) G. E. 11950/6900-230/460 V.
250 KVA (2) G. E. 6600-2300 V.
150 KVA (2) Maloney 2300-230/460 V.
150 KVA (2) Furnace Type 6600-90
100 KVA (3) Al. Chal. 22000-440 V.
100 KVA (2) G. E. 13200/6600-440/600 V. & small sizes.
3 Ph. Transformers
750 KVA Wagner 6600-2200 V.
500 KVA (4) G. E. 13200-120/208 V.
300 KVA (2) G. E. 13200-120/208 V.

1—400 HP Westinghouse, type CW, 3 ph. 60 cy. 440V, 450 RPM slip ring motor
1—300 HP Westinghouse, 3 ph, 60cy, 440V, CW slip ring motor 495 RPM
2—250 HP General Electric, 3 ph, 60 cy, 440V 1-17A 400 RPM
2—200 HP Allis Chalmers, 3-60-440V, 514 RPM
2—150 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring
1—150 HP General Electric type KT, fr. 558 3-60-2200V 880 RPM
1—150 HP General Electric, type ATI, 3 ph, 60 cy, 440V 900 RPM, 0.8 PF syn. motor
1—150 HP Electric Mach. syn. motor, 125 KVA, 3-60-220V, 1200 RPM
1—150 HP General Electric, 3-60-440V
1—17A 360 RPM slip ring
1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW, 390 RPM slip ring
1—150 HP G. E., 3 ph, 60 cy, 440V, 1170 RPM, type 1-6
2—125 HP Westinghouse CS774C 3-60-440V 860 RPM Ball Bearing
4—160 HP General Electric, 3-60-440V, 495 RPM, MT 562 slip ring
1—100 HP General Electric type I, form K, 3-60-220V 575 RPM

**Factory built, 3 bearing, Westinghouse motor-generator set, 16½ KW, 650 amp., 25 volt, 1750 RPM, SK 93, generator direct connected to 26 HP, 230 V, DC, SK 83 motor with complete panel.**

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring
1—100 HP, G. E., 3 ph, 60 cy, 440V, 580 RPM, type 1-15
2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V 450 RPM slip ring
1—75 HP Westinghouse, type CW, 3 ph, 60 cy, 440V, 720 RPM slip ring, 3 or 2 bearings
1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring
1—75 HP General Electric, 3 ph, 60 cy, 440V, 500 RPM, MT558 slip ring
1—75 HP Western Elec. type I, 3-60-440V, 690 RPM
1—75 HP General Electric, 3-60-440V, type I, 575 RPM
1—75 HP, G. E., 3 ph, 60 cy, 220V, 1165 RPM, type KT-347
3—25/65 HP Westinghouse, frame 762C, 3-60-440V, 600/1200 RPM, 2 speed slip ring motor
1—60 HP General Electric type KT, frame 348, 3 ph, 60 cy, 440V, 870 RPM
1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage 900 RPM
1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric 3-60-440V, KT542, 870 RPM Sq. Cage
1—60 HP, Westinghouse, 3 ph, 60 cy, 220V 1160 RPM, type CS-644C
1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, KT-346, 870 RPM, Sq. Cage
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP Howell 3-60-440V, 870 RPM, type SCBB ball bearing Sq. Cage
1—50 HP General Electric, 3-60-440V, 720 RPM, type I-K, Sq. Cage
2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring
1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring
1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring
3—50 HP General Electric 3-60-440V, 575 RPM, type I-K, fr. 13A, Sq. Cage
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers 3-60-440V, 490 RPM, Sq. Cage
1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D
1—50 HP, Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing

**We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.**

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM
1—60 HP Westinghouse, type SK, frame 160, 230V, 680 RPM
1—60 HP Westinghouse type SK140L, 115V, 1150 RPM vertical
1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM
1—50 HP Westinghouse SK200, 245 RPM 230V
1—DC Generator 45KW Bullock 120V, 375A, 900 RPM
2—40 HP C & C 230V, 250/1000 (planer)
2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-19A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage
1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring
1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane
1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring
1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS, Sq. Cage
2—30 HP, Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing
1—30 HP, Wagner, 3 ph, 60 cy, 440V, 900 RPM, type 19TCM, totally enclosed fan cooled, ball bearing

# The Wente Electric Co.,

## Hamilton, Ohio

***REBUILT MOTORS & GENERATORS SINCE 1906***

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**FOR SALE BY OWNER**

## POWER PLANT EQUIPMENT

**BOILERS and STOKERS**

**B. & W. Boilers 1-440 Cross Drum—6-500-750 H.P. with Stokers, 200# pressure**
**2—183 H.P. 150# Bigelow Boilers**
**10 Ton Handcrane and Runway Complete**

**TURBO GENERATORS**
**from 500 to 15000 K.W.**

**Diamond Soot Blowers, 38 sets, 2" x 2½" valve in head**

Transformers up to 5000 Kva.—3—2500 Kva, 9—300 Kva, 3—500 Kva. Number of smaller sizes.

Also have in stock oil circuit breakers up to 3,000 amps. and 74,000 volts—disconnect switches up to 6000 amps.

Stock of 5,000 current and potential transformers of all sizes, all kinds of relays, overload, underload, heat element, etc.

We also buy complete plants outright. What have you for sale?

**HOWE BROTHERS**
324-328 Pearl Street New York, N. Y.
Telephone Nos. Worth 2-2708—2709—2710

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**PLUMBING SUPPLY CO., INC.**
Power Plant Valves and Engineering Specialties for Oil, Steam, Gas, Air, Liquids and Chemicals.
Jenkins, Fairbanks, Sarco, Powell Valves and surplus.
Large Complete Stocks ⅛" to 24"
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For Hourly Nation-wide Shipments
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List your Surplus and Replaced equipment with us. We will help you find a buyer.
Send us details of your needs.
***Our Available Equipment List may include what you require.***
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## FOR SALE

250 K.W. GENERAL ELECTRIC A. C. GENERATOR type ATI-32-312M-225, Form S. 225 RPM, P.F. .8, 75.5 amps., 3/60/2300 volt. Pedestal sole plates. Includes G.E. exciter 17½ KW, type RC compound wound & switchboard.

**ALJON ELECTRIC DIESEL CO.**
151-55 Washington St. B'klyn, N. Y.
Main 4—3804—5

### SLIP RING MOTORS, 3 PH., 60-CY.

| HP | Volts | Make | Speed |
|---|---|---|---|
| 900 | 2200 | G.E. | 900 |
| 600 | 2300 | Whse | 514 |
| 450 | 2300 | G.E. | 600 |
| 400 (2) | 400 | Whse. | 514 |
| 400 | 2300 | Whse. | 1200 |
| 350 | 220–440 | G.E. | 1800 |
| 350 | 2200 | G.E. | 600 |
| 300 | 2300–4000 | G.E. | 1200 |
| 250 | 2300 | G.E. | 600 |
| 250 | 440–550 | G.E. | 600 |
| 200 | 2200–550 | G.E. | 1800 |
| 200 | 2200–400 | G.E. | 600 |
| 150 | 440–220 | G.E. | 1800 |
| 150 | 2200 | G.E. | 900 |
| 150 | 440 | G.E. | 1800 |
| 150 | 550–2200 | G.E. | 1800 |
| 125 | 440–220 | G.E. | 600 |
| 100 | 550–2200 | G.E. | 720 |
| 100 | 440–220 | G.E. | 1800 |
| 100 | 220–440 | G.E. | 720 |
| 100 | 220–440 | G.E. | 900 |
| 75 | 220–440 | G.E. | 600 |

### SYNCHRONOUS MOTORS, 3-PH., 60-CY.

| | | | |
|---|---|---|---|
| 600 | 2200 | Whse. | 900 |
| 400 | 440–220 | Whse. | 276 |
| 350 | 440–220 | G.E. | 900 |
| 240 | 2300–440–220 | G.E. | 600 |
| 200 | 2300–4000 | G.E. | 1200 |
| 150 | 2200 | G.E. | 1800 |
| 110 | 440 | Whse. | 900 |

### PUMP

1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

### OUTDOOR OIL CIRCUIT BREAKER

1—New 400 Amp. Type FK, 136-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

### TRANSFORMERS—60 CYCLE

3—667 kva., G.E., 2300/4000-460/480 Volts.
3—667 kva , Whse., 22000-2300.
3—500 kva., Whse., 22000-2300.
3—350 kva., G.E., type H-KD 13200-4600.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., Whse., 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
2— 50 kva., Whse., 22,000-2300.

### SQUIRREL CAGE MOTORS

| HP | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 500 | 440/220 | G.E. | IK | 1200 |
| 550 | 440/220 | G.E. | IK | 900 |
| 400 | 440 | G.E. | KTP | 1200 |
| 400 | 2200 | Whse. | C.S. | 1800 |
| 300 | 2200 | G.E. | IE-K | 1800 |
| 250 | 2200 | G.E. | IK | 600 |
| 200 | 220/440 | G.E. | IK | 720 |
| 150 | 2200 | Allis. Ch. | AN | 480 |
| 100 | 2200 | G.E. | IK | 600 |
| 100 | 2200 | G.E. | IE-K | 1800 |
| 100 | 550 | G.E. | KT | 900 |
| 100 | 220/440 | G.E. | KT | 720 |
| 75 | 2200 | G.E. | KT | 900 |
| 75 | 2300 | G.E. | IE-K | 1800 |
| 50 | 220/440 | G.E. | K | 1800 |

### MOTOR GENERATOR SETS

75 KW, 125 V, 1200 RPM Westinghouse Conn. to 112 H.P. 2300/440 V, 3 ph, 60 cy. Ind. motor.
1—75 KW 125 V, 1200 RPM, GE Conn to 160 HP 440 V. 3 ph. 60 cy. Ind. motor.
1—75 KW 250 V. 1800 RPM, Cr. Wh., Type CCD con. to 100 H.P., 2200 V., 3 ph., 60 cy. syn.
1—50 KW 250 V. 900 RPM, Whse. SK 607 to 75 HP 440/220 V. 3 ph. 60 cy. Ind.

### A.C. GENERATORS

1—500 kva., 900 r.p.m., 2300 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—225 kva., 600 r.p.m., 2200-240 V., G.E.
1—187 kva., 900 r.p.m., 2200-550 V., Westghse.
1—110 kva., 900 r.p.m., 440 V. G.E.
1— 25 kva., 3600 r.p.m., 220 V. G.E.

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HARRY J. RICE PRES.

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## FOR SALE

12x13; 11x11; 10x12 EMPIRE DONKEYS.
Motors, 5 to 1000 h.p.
No. 11S London; 21E Koering Cement Mixers.
450 Head Pumps; 90 to 500 gallons.
Foundry Compressor 8x8; IR 10x12.
IR 14x14 Holman 6¾x7; 2 cylinder.
Broom & Wade 10x12; 2 cylinder; Rand 14x9x12.
IR 19½x12x10; IR 4x4.

### STEAM ENGINES
**With or without Generators**

Twin City Corliss, 275 h.p. McEwen 250.
Port Huron 50 h.p. Northy 8x10.

### DIESELS AND GENERATORS

Hill 50 h.p. 4 cylinder, direct connected, 15 k.w. AC 110-220.
Electric Starting 8-switch board, 2 years old.
75 h.p. Buda 20 k.w. 220-volt AC.
260 h.p. Buckeye, direct connected to 217 G.E. 2300—220 or 440.
Air Starting and switch board.

### GAS ENGINE GENERATORS
**Push Button Starting**

10 K.V.A. 110 volt AC Switchboards.
20 K.V.A. 220 volt AC Switchboards and radiator.
100 K.V.A. 2200 volt AC, cooling.
50 h.p. 500 and 1000 k.w. steam turbines.

### TRANSFORMERS

150 K.V.A., 6600—550
English Electric 60 cycle, single phase.
Hydro Generators, 50 to 1200 K.V.A.

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Vancouver, B. C., Canada

## POWER PLANT EQUIPMENT

### Turbo-Generators

1—5000 KW GE Cond. 2300 V.
1—4000 KW GE Cond. 2300 V.
1—3000 KW GE Cond. 600 V.
1—2000 KW GE Cond. 2300 V.
1— 750 KW West Cond. 6600 V.
1— 600 KW GE Cond. 600 V.
1— 500 KW GE Cond. 600 V.
1— 500 KW GE Cond. 125 V D.C.
1— 200 KW GE Cond. 2300 V.
1— 100 KW GE Cond. 600 V.
1— 75 KW GE N.C. 125 V. D.C.

### Turbines Only

1—450 HP GE 175#
1—210 HP Terry 250#
1—175 HP GE 110#

### Boilers

1—750 HP Heine 200# Stoker
3—318 HP Manning Type 170#
1—300 HP Heine 250# Stoker
2—300 HP Sterling Type 160#
2—150 HP HRT 150# Grates

### Air Compressors

1—1214 CFM 100# Motor Driven
1—1080 CFM 85# Motor Driven
1—825 CFM 100# Steam Driven
1—600 CFM 500# Steam Driven
1—146 CFM 1200# Belted

### Centrifugal Compressors

10000 CFM 33# Turbine Driven

### Pumps

2—3000 GPM 65' Hd. Motor Driven
1—1500 GPM Fire Pump Steam
1—1000 GPM Fire Pump Steam

### Engine—Generators

1—600 KW GE 2300 V.

### Belted Generators

1—550 KW GE 360 RPM 2300 V.
1—450 KW GE 360 RPM 600 V.
1—15 Ton Crane Hand Operated
1—150 HP Motor 720 RPM 2200 V.

*Also transformers, engines and cranes*

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The Buyer Must Be Satisfied—Always

### 120 KW ENGINE GENERATORS SET

1—120 KW G.E. Co. Type TRE Generator, 3/60/2300 volts, direct connected to 125# Harrisburg Fleming Steam Engine.

### HOIST

1—50 HP Lidgerwood Double Drum Hoist, 24 x 24" drums, side by side, with or without AC or DC motor.

### DEEP WELL PUMPS

2—600 GPM, 116 ft. head, Kingsford, size #4 Deep Well Pumps with 40 HP G. E. Co. Type CD-93, 230 V. DC vertical motors.

### TURBO COMPRESSOR

1—675 C.F.M., 24 Oz. Press. Spencer Turbo Compressor, requires 7½ HP, 1700 RPM Motor.

## ELECTRIC EQUIPMENT FOR INDUSTRY

LET US KNOW YOUR REQUIREMENTS

REBUILT & GUARANTEED STOCK
MOTORS, D.C. & A.C. TRANSFORMERS
MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

### SYNCHRONOUS MOTORS

2—150 HP W.E. Co. Type G, 80% P.F. for 3/60/220-440 volts, 1200 RPM, with direct connected exciters.
2—250 HP W.E. Co. Type HR, 100% P.F. for 3/60/2300 volts. Engine Type, one (1) at 240 RPM, one (1) at 277 RPM.

### 100 KW ROTARY CONVERTER

1—100 KW G.E. Co. Type TCC for 250 V—DC and 3/60/2300 V—AC. Transformer and Switchgear, 1200 RPM.

### CENTRIFUGAL PUMPS

2—2700 GPM, 170 ft. head Lecourtnay Centrifugal Pumps driven by 150 HP W.E. Co. Type G, 80% P.F. Synch. motors 3/60/220-440 volts, 1200 RPM.

### PLATFORM SCALE

1—15 ton Fairbanks Industrial Platform Scale, 5' x 8'.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

*FOR DETAILS, WRITE* **JOHN D. CRAWBUCK CO.** *714-15 EMPIRE BLDG. PITTSBURGH, PENN.*

# CHICAGO ELECTRIC—GUARANTEED REBUILT EQUIPMENT

2—1500 KW MGS.
2—1500 KW Wtg. 2500 d.c. dir. conn. 2250 hp. Syn. 360 rpm. 3-60-12000/2300 V.

### MOTOR-GENERATOR SETS

| KW | Make | DC volts | AC volts |
|---|---|---|---|
| 1500 | Wtg. | 250 | 2300 SYN |
| 1000 | G.E. | 600 | 4400/2200 |
| 1000 | Wtg. | 275 | 4160/2300 |
| 750 | G.E. | 275 | 440 |
| 300 | Al. Ch. | 600 | 2300 syn. |
| 250 | G.E. | 600 | |
| 200 | 3-unit | 80v.DC | 250 v. DC |
| 235 | Westg. | 110 | 2200 |
| 225 | Ideal | 115 | 2200 |
| 200 | Westg. | 250 | 440/2200 |
| 150 | Cr. Wh. | 250 | 2300 |
| 150 | Ideal | 250 | 440 |
| 150 | Ridg. | 250 | 2300 |
| 100 | G.E. | 250 | 2200 |
| 100 | Westg. | 125 | 2200 |
| 100 | Al. Ch. | 125 | 440 |
| 100 | Westg. | 250 | 220/440/2200 |
| 90 HP | Westg. | 110 | 75 Kva 2200 ac |
| 75 | G.E. | 250 | 2200 |
| 75 | G.E. | 125 | 220 |
| 50 | Al. Ch. | 3-w. | 2200 |
| 50 | G.E. | 125 | 4000 |
| 50 | Westg. | 250 | 2300 |
| 15 | G.E. | 230 | 220 |
| 15 | Ster. | 240 | 220 |
| 7½ | Jenny | balance set | |

### SLIP RING MOTORS

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 30 | Wagner | BR | 850 |
| 1 | 30 | Westg. | HF10A | 860 |
| 1 | 15/35 | Westg. | CW654C | 575/1150 |
| 1 | 30/15 | G.E. | OMT336 | 1155/550 |
| 1 | 35 | F. Mse. vert. | UVA | 1800 |
| 1 | 35 | G.E. | I-M13 | 600 |
| 1 | 35 | G.E. | I-M-13 | 600 |
| 1 | 40 | G.E. | MT-Int. | 1200 |
| 1 | 40 | Wagner | 22TBR | 1725 |
| 1 | 40 | Westg. | CW | 1160 |
| 1 | 40 | Wagner | BR | 850 |
| 1 | 40 | Westg. | HF | 690 |
| 1 | 50 | Westg. | HF11AH | 1180 |
| 1 | 50 | Al. Ch. | | 1160 |
| 1 | 50 | West. | HF | 860 |

### FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300 Form C, 3 ph. 60 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. synchronous motor with amort. wdg., dir/conn. to 1000 KW General Electric types ATI-10-1250M-300, 3 ph, 25 cy, 450 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. A.C. generator with amort. wdg., with 33 KW G. E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

### 25 CYCLE—M. G. SETS

1—74 KW General Electric type CL6, 126 v., compound wound, D.C. generator, 2 brg., dir. conn. to 110 HP type I-K, 3 phase, 25 cycle 230 v., 750 RPM sq. cage motor.

1—75 KW General Electric type DLC-206A, compound interpole, 3 brg. D.C. generator, dir. conn. to 115 HP type I-K, 3 phase, 25 cycle, 440 volt, 750 RPM, sq. cage motor.

### SLIP RING MOTORS

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 50 | F.M. | HV | 720 |
| 1 | 50 | Westg. | CW752C | 690 |
| 1 | 50 | G.E. | I-M | 685 |
| 1 | 50 | Al. Ch. | ARY | 690 |
| 1 | 50 | G.E. | I-M | 600 |
| 1 | 50 | Wtg. | CW855 | 570 |
| 1 | 50 | G.E. | MTC5342 | 565 |
| 1 | 50 | Al. Ch. | | 720 |
| 1 | 60 | Westg. | CW | 600 |
| 3 | 75 | Al. Ch. | ARY | 900 |
| 1 | 75 | Westg. | F | 720 |
| 1 | 75 | G.E. | M-12 | 600 |
| 1 | 75/94 | N. West | HW | 1800 |
| 1 | 100 | G.E. | I | 600 |
| 1 | 100 | Al. Ch. 2200 v. | | 600 |
| 1 | 100 | Westg. 2200 | CW | 600 |
| 1 | 100 | Westg. | HF | 230 |
| 1 | 150 | G.E. | MT | 900 |
| 1 | 150 | Westg. | CW | 600 |
| 1 | 150 | Al. Ch. | | 580 |
| 1 | 150 | Wagner | BR | 1140 |
| 1 | 150 | Westg. 2200 | CW | 375 |
| 1 | 200 | G.E. | IE | 1200 |
| 1 | 200 | Howell | S | 600 |
| 1 | 200 | Westg. | CW | 345 |
| 1 | 250 | Al. Ch. 2200/400 | | 600 |
| 1 | 250 | G.E. Slipring vert. | | 1200 |
| 1 | 300 | G.E. Slipring | I-M2200 | 514 |
| 1 | 300 | G.E., 3-brg. | MT-410 | 450 |
| 1 | 300 | G.E. with outboard brg. | I-P | 450 |
| 1 | 350 | G.E. | MT-432V- | 300 |
| 1 | 350 | Allis C. | | 300 |

### VARIABLE SPEED MOTORS 230 Volt D. C.

| HP | Make | Type | Speed |
|---|---|---|---|
| 1 | Cr. Wh. | CM | 500/1000 |
| 1 | Electro-Motor | | 420/1680 |
| 1½ | Cr. Wh. | CM | 925/1210 |
| 2 | G.E. | RC4 | 600/1000 |
| 3 | Gen. Elec. | CD | 1050/1700 |
| 4 | Sprague | C | 800/1400 |
| 5 | Burke | AM12 | 500/1500 |
| 5 | Burke | Wam12 | 960/1950 |
| 7½ | Reliance | 46T | 875/1200 |
| 12½ | G.E. | C | 700/1400 |
| 20 | G.E. | RF12 | 500/1500 |
| 20 | G.E. | RLC | 500/1500 |
| 20 | G.E. | RC11 | 500/1500 |
| 25 | G.E. | DLC | 500/1000 |
| 35 | Wtg. | SK140 | 500/1500 |
| 40 | G.E. | LC | 825/2000 |
| 40 | Chandysn. | | 250/1500 |
| 50 | Gen. Elec. | RC14 | 500/1500 |
| 50 | G.E. Sprague | C | 575/1000 |
| 50 | Westinghouse | SK | 500/1000 |
| 60 | Electro Dyn. | | 450/900 |
| 90 | Westinghouse | SK | 575/1150 |
| 35/100 | G.E. | CD165 | 425/850 |
| 100 | Gen. Elec. | CD147 | 450/1150 |
| 100 | Gen. Elec. | | 1100/1800 |
| 200 | Gen. Elec. | MD | 300/450 |
| 700 | Gen. Elec. | MPC | 450/600 |

### BOILERS

100—HP Scotch Marine 100#
2—500 HP B & W 150# ASME
2—750 HP Edgemoor 175#
3—361 HP B & W Stirling
1—516 HP B & W 20#, stoker
2—250 HP Union, Taylor stoker
3—400 HP B & W Stirling 200#
3—308 HP Heine ASME 180#
1—518 HP Heine 180# ASME

### CONVERTER

165 Gen. Elec. type HCC-6-165 form P, 6 ph. 60 cy. 1200 RPM AC to 125/250 V. D.C. comp. intp. with transf. & sw. gear.

### SQUIRREL CAGE

| | | | | |
|---|---|---|---|---|
| 1 | 75 | Al. Ch. | AN | 680 |
| 3 | 75 | Al. Ch. | 345 | |
| 5 | 75 | G.E. | | 600 |
| 1 | 100 | Al. Ch. | | 1800 |
| 1 | 100 | Al. Ch., vert. | | 1200 |
| 3 | 100 | Westg., 2200/220/440 | CS | 1200 |
| 1 | 100 | West. El. | KT | 900 |
| 1 | 100 | G.E., 2200 v. | IK | 900 |
| 1 | 100 | Al. Ch., 2200 v. | | 450 |
| 2 | 125 | G.E., 2200 v. | KT547 | 1800 |
| 2 | 125 | G.E., 2200 v. | KTP | 1800 |
| 4 | 125 | G.E. | KT | 720 |
| 1 | 150 | Westg., 2200 v. | CS | 1716 |
| 1 | 150 | Al. Ch. | | 1200 |
| 1 | 150 | G.E. | K-558 | 900 |
| 1 | 150 | Westg., 2200 v. | CS | 1800 |
| 1 | 150 | G.E. | IK | 600 |
| 2 | 150 | Westg. | CCL | 495 |
| 1 | 200 | Westg. | CS | 3600 |
| 3 | 200 | F. Morse, B.B. | | 1800 |
| 1 | 200 | G.E., 2200 v. | KT | 1800 |
| 1 | 200 | G.E. | IK | 1200 |
| 1 | 200 | G.E. | IK | 600 |
| 1 | 200 | Westg. | CS | 600 |
| 1 | 225 | G.E., 4160 v. | FT | 3600 |
| 1 | 225 | G.E., 2200 | I-E | 1800 |
| 4 | 250 | Fair, M.B.B., 2200 v. | | 1800 |
| 1 | 250 | Ideal | A | 1200 |
| 1 | 250 | F. Morse B.B. | 3-brg. | 900 |
| 2 | 400 | G.E., 2200 v. | I-K | 1800 |
| 1 | 400 | Al. Ch. | | 600 |
| 1 | 700 | G.E., 2200, drip-proof constr. | KF | 1800 |
| 1 | 1000 | G.E., 2200 v. | K | 509 |

## CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

### BOILERS

1—528 HP Heine, 350 lb. with underfeed stoker.
1—335 HP B & W Sectional Header Boilers, 200# preasure with superheaters, hand fired grates.
1—250 HP Casey-Hedges, 160 lb. pressure.
1—400 HP Wickes 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. Badenhausen Boiler, 354# pressure.
1—357 HP HEINE with Riley Underfeed Stoker.
2—600 HP B & W sectional header boilers, 200# pressure.
2—300 HP Heine 175# pressure.
2—492 HP Sterling Boilers, 160# pressure.
2—1452 HP B & W boilers, 350# pressure, underfeed stokers, complete plant.
1—394 HP Sterling Boiler chain grate stoker, 160# pressure.
1—585 HP Erie City vertical boiler 185# pressure, Type E stoker.
2—253 HP Sterling Boilers, 160# pressure with oil burners.
1—444 HP Union Iron Works Boiler, 225# pressure.
2—500 HP Edge Moor Boilers 200# pressure.
4—500 HP Voigt Water Tube Boilers 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP B & W Sectional Head Boiler 150# pressure, underfeed stoker.
1—522 HP Sterling Boiler 200# pressure with Firite Stoker.
1—600 HP Stirling Boilers, 200 lb. pressure.
1—484 HP Springfield Boiler, 250# pressure oil burners.
1—Complete Power Plant consisting of 2—309 HP Heine Marine Boilers, 223# pressure and 2 General Electric Turbines with all auxiliaries.
2—150 HP HRT Boilers, 150# pressure.
4—750 HP Bigelow Hornsby 225# pressure with pulverizers.
4—1010 HP Heine watertube boilers 250# pressure.
1—400 HP Connelly Boiler 160# pressure with new tubes and auxiliaries.
2—84" x 20' HRT Boilers, 150# pressure all auxiliaries.
1—150 HP HRT, 125# pressure, rebuilt and guaranteed.
56—50 HP Vertical Boilers 150# pressure all auxiliaries.

### TURBINES

1—5000 KW Westinghouse 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
1—2500 KW General Electric Condensing Turbine with auxiliaries.
1—2500 KW General Electric Turbine 400# pressure. Surface condenser.
1—1000 KW Westinghouse non-condensing turbine 350# pressure 16# back pres.
1—937 KVA Allis-Chalmers Turbine.
1—625 KVA General Electric Turbine with jet condenser.
1—2000 KW Westinghouse Turbine with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP Kerr Non-condensing 3600 RPM Turbine.
1—250 KVA Waite Turbine either condensing or non-condensing.
1—250 KVA General Electric non-condensing Turbine.
1—125 KW General Electric non-condensing Turbine.

### ENGINE GENERATOR SETS

260 KVA Skinner uniflow engine.
1—750 KVA Rice & Sargent 3-60-600 volt engine generator.
1—480 KW Rice & Sargent 3-60-550 volt engine.
1—250 KVA Ridgeway engine generator set.
2—187½ KVA Skinner Uniflow Engines.
17 inch by 18 inch Skinner uniflow engine.
1—166 KVA Ames Uniflow engine generator set.
1—260 KVA Skinner uniflow engine.
2—625 KVA Bates-Corliss engines.
1—48" x 150' steel stack.

### DIESEL ENGINES

2—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
4—312 KVA MAN full diesel engine generators, solid injection, 4 cycle.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
800 KVA Nordberg, full diesel engine generator.

### ENGINE GENERATOR SETS

1—625 KVA Nordberg Uniflow engine.
1—1000 KVA Skinner Uniflow engine.
400 KW Skinner Uniflow Engine Generator set.

### MISCELLANEOUS

54,000 pound Cochrane hot process lime and water softener.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
1—#8 Fuller Bonot Pulverizer.
2—11 retort Taylor stokers.
1—800 HP Hoppes open feedwater heater.

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## FLETCHER SALES CO.

325 Fincastle Building LOUISVILLE, KY.

## JUST A FEW ITEMS OF OUR COMPLETE STOCK FOR IMMEDIATE SHIPMENT

### PUMPS

| G.P.M. | Head | Make | Type |
|---|---|---|---|
| 9700 | 110′ | Ing. Rand | Centrif. |
| 6000 | 133′ | LeCourtenay | Centrif. |
| 3000 | 40′ | Cameron | Centrif. |
| 300 | 500′ | Goulds | Triplex |
| 240 | 460′ | Worth. | Triplex |
| 175 | 500′ | Worth. | Triplex |
| 500 | 175′ | Blackmer | Rotary |
| 450 | 231′ | Kinney | Rotary |
| 200 | 175′ | Blackmer | Rotary |
| 1500 | 460′ | Platt | Steam |
| 1000 | 460′ | Knowles | Steam |
| 500 | 460′ | Knowles | Steam |
| 2000 | 50′ | Lawrence | Sump |
| 300 | 231′ | Gardner | Plunger |

### STEAM ENGINE GENERATOR SETS

### BOILER FEED PUMPS

| K.W. | Make | Volts | Type |
|---|---|---|---|
| 100 | Ames | 240 | dir. dr. Eng. |
| 75 | Ames | 120–240 | dir. dr. Eng. |
| 50 | Ball & Wood | 125 | dir. dr. Eng. |
| 50 | G.E. | 250 | dir. dr. Eng. |
| 35 | Sturt. | 250 | belt dr. |
| 25 | Greenfield | 115 | belt dr. |
| 25 | Ball & Wood | 125 | dir. dr. |

### MOTORS (D.C.)

100 Northwest. 220 1750
25 Imperial 220 450
25KW Fair. Morse 110 1050

### STORAGE TANKS

5 to 30000 Gal. Steel-welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

### CONDENSATION RETURN UNITS

Nash-Jenn. Dup. Vac. Heat. 26000EDR
Nash-Jenn. Simp. Vac. Heat 16000EDR
Skidmore Vac. Heat. 20000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

### AIR COMPRESSORS

| C.F.M. | Pressure | Make | Type |
|---|---|---|---|
| 850 | 100 | Laidlaw | Hor. Dup. |
| 500 | 60 | Ing. Rand | Steam |
| 400 | 125 | American | Horiz. |
| 350 | 40 | Worthing | Horiz. |
| 250 | 100 | Ing. Rand | Horiz. |
| 220 | 100 | Gardner | Gas. Eng. |

### TURBO-CENTRIFUGAL BLOWERS

| | | | |
|---|---|---|---|
| 3000 | 16 lbs. | In. Rand | Motor dr. |
| 2300 | 3 lbs. | Spencer | Motor dr. |
| 900 | 5¼ lbs. | In. Rand | Motor dr. |
| 700 | 2½ lbs. | Allen Bilimyer | Motor dr. |
| 675 | 24 oz. | Spencer | Motor dr. |
| 400 | 16 oz. | Spencer | Motor dr. |
| 150 | 2 lbs. | Allen Bilimyer | Motor dr. |

### BLOWERS

| C.F.M. | St. Pres | Makes | Type |
|---|---|---|---|
| 100–60000 | ¼"–5" | Buffalo | Various |
| 100–15000 | ¼"–16 oz. | American | Various |

### ROTARY PRESSURE BLOWERS

| C.F.M. | Press. | Make | Type |
|---|---|---|---|
| 10000 | 2 lbs. | Roots | Belt dr. |
| 6000 | 3 lbs. | Roots | Belt dr. |
| 3000 | 3 lbs. | Roots | Belt dr. |
| 2000 | 3 lbs. | Sturt. | Belt dr. |
| 1000 | 3 lbs. | Roots | Belt dr. |
| 200 | 5 lbs. | Baker | Dir. dr. |
| 110 | 15 lbs. | Beach R. | Belt dr. |

### VACUUM PUMPS

| | | | |
|---|---|---|---|
| 1000 | 15 in. | Roots | Belt dr. |
| 350 | 27 in. | Worth. | Belt dr. |
| 300 | 27 in. | Nash | Belt dr. |
| 100 | 27 in. | Deane | Belt dr. |
| 200 | 29 in. | Devine | Belt dr. |

### MOTORS (3 ph. 60 cy.)

| H.P. | Make | Volts | Speed | Type |
|---|---|---|---|---|
| 300 | G.E. | 230/4000 | 1800 | Syn. |
| 200 | West. | 440 | 690 | HF |
| 175 | G.E. | 440 | 1150 | I |
| 100 | Lincoln | 220 | 1750 | |
| 50 | G.E. | 2300 | 1750 | I |
| 50 | West. | 220 | 850 | CCI. |
| 50 | West. | 220 | 570 | CS |
| 40 | G.E. | 220 | 870 | 342 |
| 30 | Wagner | 220 | 850 | sl. rg. |
| 30 | Wagner | 220 | 1150 | |

### STEAM ENGINES

11"x12" G. E. Vertical
10"x10" Sturtevant Vertical
10"x10" Greenfield Vertical
3"x4" Erie Vertical
7"x7" Wickes Bros. Vertical
6"x6" Lawrence Vertical
1 to 25 H.P. Steam Turbines

*SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES*
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## DIESEL UNITS

50 H.P. Buda 32 KW, 125 V.D.C.
3—30-40 & 50 KW Gen. Motors 3/60/208 V.
100 H.P. Fairbanks Morse VA Engine.
100 H.P. Wolverine 3/60/480 V.
120 H.P. Muncie 125 V.—D.C.
120 H.P. DeLavergne, 3/60/220 V.
180 H.P. Fairbanks Morse 32E12 Engine.
200 H.P. McIntosh, 3/60/240 V.
250 H.P. Busch Sulzer 4B60 Engine.
265 H.P. Worthington 3/60/440 V.
550 H.P. Nelseco Marine Engine.

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60 East 42nd St. New York, N. Y.

## 1—4000 KVA. 60 CY 3 Ph. TURBOS with Surface Condensers—4800v. 60-cy. 3-ph.

### HYDRO ELECTRIC UNITS

1625 KVA. 60 Cy., 250 RPM.
750 KW. 360 RPM. 60′ Head.
700 KW. 257 RPM.
1500 HP. Impulse, 150 RPM.
1600 HP. 550′ Head.
HEAT EXCHANGER 606 tubes 1¼"x9'6".

**1—New FAN 66750 CFM**

## 1500 CFM 2 STAGE AIR COMP. 275 H.P. 2300 v. 60 Cy. 3 Ph. Syn. Motor Dr.

24" Back Pressure Valve F&D.
3—20" VALVES—F&D, also Ells & Tees.
200 KW. and 125 KW. ENGINE SETS (2303 V. 60 Cy. 3 Ph. with Auxls.)
3—550 HP. STIRLING BOILERS 200#.
2—CENT. PUMPS, 4166 GPM, 162′ Head.
1—3600 GPM, 27′ head CENT. PUMPS.
TRAVELING CRANE, 75 ton Case, 64′ Span, 3 Motors. Also others.
1—M-G SET. Motor 225 HP. 4100 V. 60 Cy. 3 Ph. driving 2-90 V. generators.
500 KW. NON-COND. 60 Cy. TURBO.

**ROSS POWER EQUIPMENT CO., Indianapolis, Ind.**

## COMPRESSOR UNIT

1—1052 cubic foot Sullivan type WN31 Air Compressor direct connected to 175 HP 2300 Volt Synchronous Motor complete with all Accessories.
1—275 HP 600 RPM 440 V 3 Brg. GE type ATI Synchronous Motor with startg. eqt.
1—125 KW 440 V 3 Phase AC Gen. dir. con. to 10" x 10" Chuse horiz. 1 cyl. vert. steam eng. and sw. brd.

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San Francisco, California
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### M-G SETS

1—West. 500 KW, 275 or 600 Volt D.C. 720 RPM, 2300 Volt, 80% P.F. 720 HP, A.C.

### VERTICAL MOTORS

1—G. E. 50 HP 1200 RPM 3 ph 60 cy 220 V.
1—Reliance Fan-cooled 25 HP 1750 RPM 220/440 V.

### SYNCHRONOUS MOTORS
3 phase, 60 cycle, A.C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

### SLIP RING MOTORS, 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 60 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

### SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220/440 Volt

1—150 HP 1750 RPM Allis-Chalmers
2—100 HP 550 RPM Westinghouse MS
1—75 HP 575 RPM Westinghouse CS—368-A
1—75 HP 600 RPM Fairbanks-Morse
1—75 HP 720 RPM Lincoln I-P
1—65 HP 860 RPM Allis-Chalmers
1—50 HP 1200 RPM Northwestern
1—50 HP 875 RPM Westinghouse CS
1—50 HP 865 RPM Ideal
1—20 HP 870 RPM West. T.E.F.C. CS—W-405
2—20 HP 870 RPM West. CS—W-405
2—15 HP 860 RPM Allis-Chalmers

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA, 277 RPM, 3 phase, 60 cycle

***The Electric Motor & Repair Co., Cuyahoga Falls, O.***

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**4—352 H.P. Sterling Boilers**
Class F—#22
3¼" Tubes—42" Drums
Green "Chain-Grate" Stokers
Pressure 160#
Jeffrey Coal Conveyor
and Bunker
Turbine Driven Boiler Feed

**1—Permutit Filter**

**1—Zeolite Softener**

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Middletown, Ohio

## READY FOR DELIVERY

125 KW 156 KVA 3/60/240 volt Cooper Bessemer 3 cyl. 12x18" 300 rpm Vertical Diesel Generator. Complete layout in good condition. Only $4500 on foundations Chicago.
1500 cfm Sullivan WN31 Synchronous M.D. Air Compressor 22x12x14" 257 rpm 100/150 lb. 3/60/2300 volt direct drive. Reconditioned guaranteed $9500 fob Cleburne, Texas.
2—PD80 International 80/100 HP Diesel Power Units. 6 cyl. 1400 rpm with radiators, base and clutch. Reconditioned, guaranteed $1950 ea. fob St. Louis.
50 ton Shaw Bridge Crane, 69′ 10" span, 42 ft. lift, 5 ton auxiliary, 110 V DC Guaranteed. $22000 fob cars California.

**Mississippi Valley Equipment Co.**
507 Locust St. St. Louis 1, Mo.

## FOR SALE

D 8800 CATERPILLAR DIESEL 4 CYLINDER DIRECT CONNECTED to 44 KVA G.E. Generator, 2/60/240 volt, etc. 900 RPM, direct con. exciter gasoline engine start and radiator. Mounted on common base. Also D 6600 Caterpillar Unit.

**ALJON ELECTRIC DIESEL CO.**
151-55 Washington St. B'klyn, N. Y.
Main 4—3804—5

## PRESSURE TANKS

6—54" diameter by 18′ A.S.M.E. 200 pounds pressure. Prompt delivery.

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800 H.P. open type feed water heater, complete with controls.
2" New Injector—2" Feed Water Filter.
Steam and Oil Separators.
Reducing, Thermostatic, back pressure—6" electric operated, Ammonia, and gate and Globe valves.
1—10 x 6 x 12 Duplex Steam Pump.

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## For immediate delivery

Turbo Generator units, Cond. & Non-Cond. Boilers
Diesel Engine Sets, Engines.

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# T-U-R-B-O – G-E-N-E-R-A-T-O-R-S

## A FEW OF THE COMPLETE UNITS NOW IN OUR STOCK

1—6000—KVA West. 3/60/2300V, 275#
1—3125—KVA GE 3/60/2300V, 200#
2—1875—KVA GE 3/60/2300V, 200#
1—1000—KW, DC, West. 3/60/250; 135/200#
2—937—KVA Allis-Chal. 3/60/2300:200#
1—250—KVA GE. Non-Cond. 3/60/480

*Also Any Capacity or Type Desired.*

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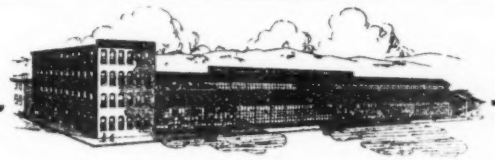

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## *Liquidation!*

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1—150 HP Erie City Scotch Marine Boiler. 150 lb. pressure. EXCELLENT CONDITION.
1—115 HP B. & W. Sterling Boiler 150# Pressure.
Approx. 500 HP of Motors, from 5 to 100 HP, with starters, all 3 ph., 60 cy., 440 volt.
Large quantity of Pipe, Shafting, Lumber, etc.

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183 VARICK STREET NEW YORK

**STEAM PUMPING ENGINES**

1—Snow 6 mgd, C&FW Cr. Com. Opp. Type Cond. 20-40x14¾x36, with waterwork type cond.
1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x13x24. Fine cond.

**PUMP VALVES**

Birch Valves for reciprocating pumps.

**LARGE GATE VALVES**

1—20" Rensselaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod & Eyebolt, 100#
1—20" Crane 125# Flanged Hand Wheel operating Gate Valve.

**BIRCH MANUFACTURING COMPANY**
1523 Sedgwick St. Chicago, Ill.

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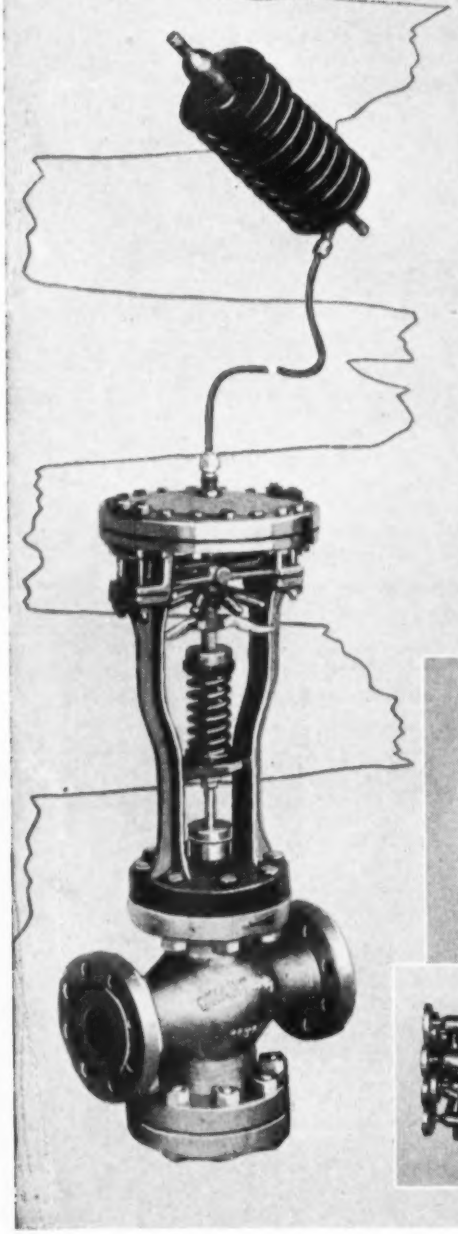
# HOW'S THIS . . .
## when you need dramatic speed in your power plant?

**From FULL LOAD to ABSOLUTE SHUTDOWN *in less than one minute***

## Handled without a murmur by Swartwout FEED WATER REGULATORS



THAT'S unusual service—but you may have a similar feed water problem some time. The equipment featured here is scheduled for a type of service that demands *speed in operation*—where boilers are required to operate anywhere from 0 to 100% of capacity. Under normal conditions, *without any warning,* they are required to go from normal load to absolute shutdown—and we mean SHUTDOWN—and be held under banked condition for sustained periods or for extremely short periods. Swartwout "S-C" Feed Water Regulators have a sound record of trouble-free performance on boilers of all pressures. *Write for Bulletin S-20-D.*

**THE SWARTWOUT COMPANY**
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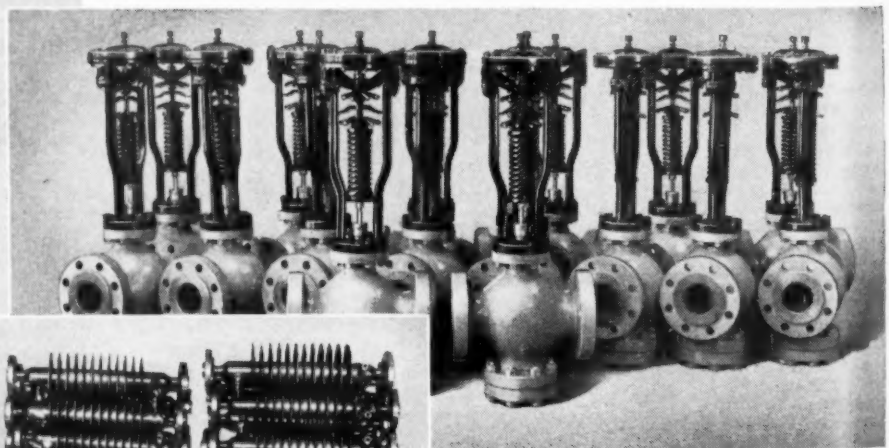
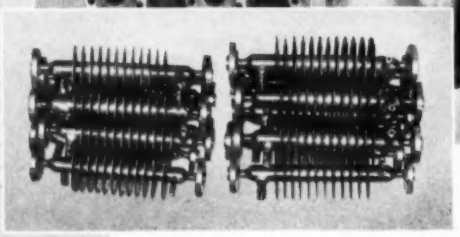
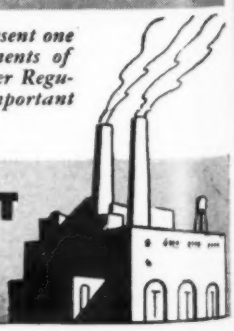




PHOTOGRAPHS *represent one of the monthly shipments of Swartwout Feed Water Regulators destined for important service.*

**Swartwout POWER PLANT EQUIPMENT**



# *Expert* PREFABRICATION
# *Pre-Engineered* SUSPENSION

Grinnell Prefabricated Piping assures faster assembly of piping and shortening of construction schedules that result from the "know-how" to interpret piping requirements and the modern facilities for expert prefabrication.

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The only hanger offering all these important features for power piping support:

Constant-support of piping in all "hot" and "cold" positions. Full safety factor of the supported system is always maintained.

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14 sizes with a load range from 84 lbs. to 4700 lbs.

Minimize changes in pipe supporting force.

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Unique swivel coupling provides adjustment and eliminates turnbuckle.

Compact — require minimum headroom.

Installation simplified by integral load scale and travel indicator.

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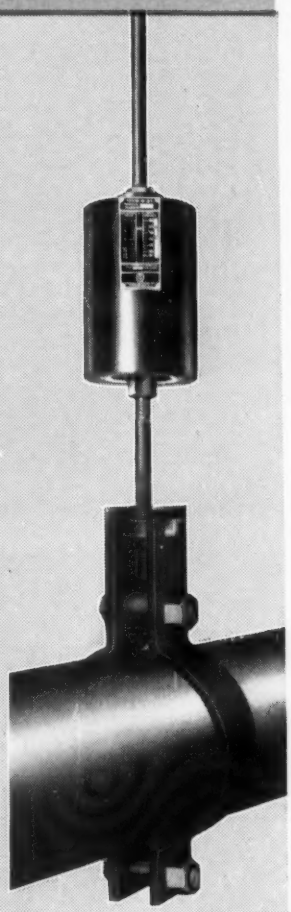

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At conveniently located fabricating plants skilled workers using the most modern equipment turn out pre-tested sub-assemblies which reduce time consuming field erection.

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☐ Pre-Engineered Spring Hangers

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# HOW TO SOLVE

Operating Problems with *Correct Lubrication*

# Keep these valves clean!

THIS IS A "HOT SPOT"—and a danger spot—in air compressor operation. If oil oxidizes and forms carbon deposits here—in the valves—it can cause high discharge temperatures with dangerous consequences.

To prevent this, you need oils that have high chemical stability to resist oxidation. These oils must also have maximum lubricating value to lubricate pistons and cylinders efficiently.

Gargoyle D.T.E. oils for compressors have the combined characteristics for this job. Their strong film protects pistons, cylinders, and valves from wear with minimum oil feeds—and these oils fight the formation of deposits to keep the valves clean.

Be sure you have these oils in your compressor for maximum efficiency with the lowest possible maintenance and lubrication costs.

GARGOYLE Lubricants

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